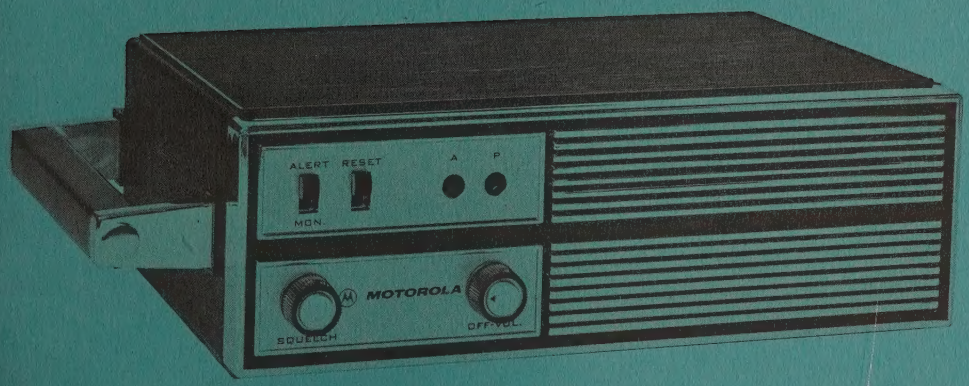


MOTOROLA

TRANSISTORIZED

ALERT MONITOR

FM RECEIVER

30-54 MC

12 VDC & 117 VAC

PRINTED IN U.S.A.

68P81050A95-A

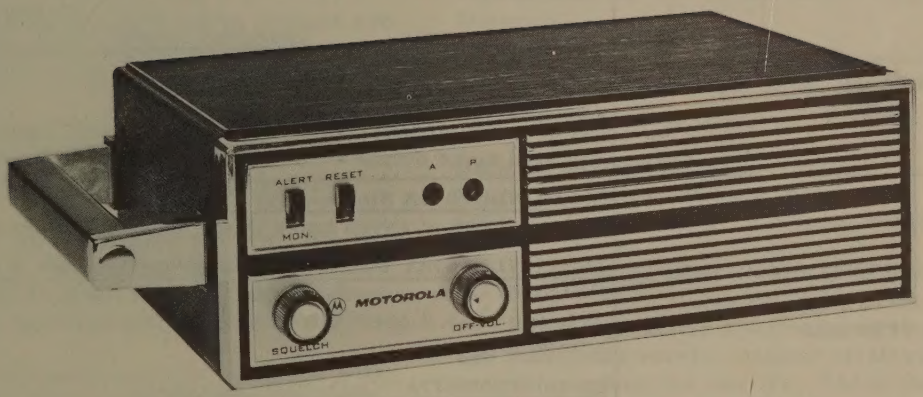
MOTOROLA

TRANSISTORIZED

ALERT MONITOR FM RECEIVER

30-54 MC

117 VAC / 12 VDC



MOTOROLA INC. Communications Division

ENGINEERING PUBLICATIONS 4501 WEST AUGUSTA BOULEVARD CHICAGO, ILLINOIS 60651

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68P81050A95
Issue - A

GUARANTEED PERFORMANCE SPECIFICATIONS

MODEL	M01CNB-1100A Series; M01CNB-3100A Series ("Private-Line" Models)
FREQUENCY RANGE	30-54 mc
SENSITIVITY	Less than 0.35 microvolt for full 20 db quieting
SELECTIVITY (EIA)	-50 db at ±20 kc
MODULATION ACCEPTANCE	±5 kc 20 kc channel spacing
SQUELCH	Noise Compensated Ajustable Sensitivity: Less than 0.18 w at threshold. Tone-Coded Type Fixed Sensitivity: Less than 0.18 w
TEMPERATURE RANGE AND FREQUENCY STABILITY	Overall stability maintained to within ±.0025% of the assigned center frequency from -30°C to +60°C ambient (+25°C reference)
SPURIOUS RESPONSE	All spurious and image responses attenuated at least 55 db
AUDIO OUTPUT	2.0 watts into a 3.2-ohm load at less than 10% distortion
SEMICONDUCTOR COMPLEMENT	19 transistors; 6 diodes
WEIGHT	6-1/4 lbs. Add: 1/2 lb for tone decoder 3/4 lb for emergency power supply
DIMENSIONS	3-1/2" high x 11-3/4" wide x 7-1/4" deep
POWER INPUT	117 v ac input: — Standard Squelch — Selective Calling Model At rated audio output = 13 watts — 15 watts +13.8 v dc input: Standby (squelched) = 90 ma — 100 ma At rated audio output = 400 ma — 475 ma
DECODER UNITS FOR SELECTIVE CALL SYSTEMS	Model NLN1046A Single-Tone Decoder *Uses any one of seven tones in the 1800 to 2400 cps range Model NLN6578A Two-Tone Sequential Decoder Unit Responds to two separate tones in sequence in the range of 304.7 to 1063.2 cps. Frequency spacing provides 47 separate available tones. Model NLN6577A "Quik-Call" Decoder Three tone bands available with twelve tones each. Frequency range: 346.7 to 1161.4 cps Model NLN6648A, NLN6649A "Private-Line" Tone-Coded Squelch Decoder Uses any one of 26 tones in the 82.5 to 192.8 cps range.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

*The seven tones available are 1800, 1950, 2000, 2100, 2200, 2250 and 2400 cps. Tone frequencies in a system should be spaced 150 cycles apart for protection against falsing.

FOREWORD

NOMENCLATURE

Motorola radio equipment is specifically identified by the model number on the nameplate.

NOTE

Be sure to use the entire model number when making inquiries about your equipment.

Identifiers have been assigned to chassis and kits. Use these identifiers when requesting information or ordering replacements.

A model chart is located in the front of this manual.

PRODUCTION CHANGES

When production and engineering changes are incorporated into the equipment, a revision numeral is assigned to the chassis or kit affected.

Typical Example:
The Model NTD6041AA becomes NTD6041AA-1 with the first revision.

This chassis number complete with revision numeral, if any, is stamped on the chassis at the time of production. The revision numeral becomes an integral part of the chassis identifier.

A schematic diagram number complete with its issue letter is also stamped on each chassis. This establishes direct correlation between the chassis and its schematic. The schematic issue is advanced each time a change occurs in the chassis.

INSTRUCTION MANUAL REVISIONS

Changes which occur after an instruction manual is printed are described in the Instruction Manual Revision. These bulletins give the reader complete information on the change including pertinent parts listing data.

NATIONAL SERVICE ORGANIZATION

Motorola provides a nation-wide service organization. Through its maintenance and installation program Motorola makes available the finest service to those desiring reliable continuous communications on a contract basis.

The largest service organization specializing in mobile communications is Motorola's National Service Organization. Over 800 strategically located, adequately staffed and trained, independently owned and operated stations, manned with several thousand FCC licensed personnel constitute the sub-contracting force.

The administrative forces of area and district service managers and district service representatives are in the direct employ of Motorola.

For your contract service requirements, please contact your local Motorola representative or write to:

National Service Manager
Motorola Communications Division
4501 W. Augusta Blvd., Chicago, Illinois 60651

REPLACEMENT PARTS ORDERING

Motorola maintains parts and service depots and authorized service stations strategically located throughout the country. These facilities are fully equipped to give the finest service.

When ordering replacement parts, the complete number identification of the item must be used whether it be a component, kit or complete chassis. This will fix proper identification and insure receipt of the desired item. Complete number identification should also be used when requesting equipment information.

Crystal orders should specify crystal type number, crystal frequency, carrier frequency and the chassis model number in which the crystal is to be used.

Orders for "Vibrasender", "Vibrasponder" and "Vibrasender-sponder" units should specify the type number and frequency and should identify the owner and operator of the communications system in which these items are to be used.

CAREFUL USE OF THE INSTRUCTION MANUAL AND THE MANY SUGGESTIONS CONTAINED IN IT WILL FURTHER INSURE PROPERLY INSTALLED AND MAINTAINED RADIO EQUIPMENT.

THE EQUIPMENT DESCRIBED IN THIS MANUAL IS MANUFACTURED UNDER ONE OR MORE OF THE FOLLOWING MOTOROLA U.S. PATENTS:

RE-24, 110	2, 738, 466	2, 925, 562	3, 083, 332	3, 200, 337	3, 281, 697
RE-24, 815	2, 740, 891	2, 938, 082	3, 087, 117	3, 204, 202	3, 284, 714
RE-26, 079	2, 743, 361	2, 963, 577	3, 087, 998	3, 205, 455	3, 298, 098
2, 524, 534	2, 759, 052	2, 966, 585	3, 087, 999	3, 217, 270	3, 292, 085
2, 547, 023	2, 759, 103	2, 974, 221	3, 091, 736	3, 218, 587	3, 293, 644
2, 547, 025	2, 777, 950	2, 984, 740	3, 094, 293	3, 221, 120	3, 295, 060
2, 547, 027	2, 799, 010	2, 994, 844	3, 101, 441	3, 223, 953	3, 300, 723
2, 583, 032	2, 808, 507	3, 009, 115	3, 119, 093	3, 233, 243	3, 304, 501
2, 608, 648	2, 809, 236	3, 014, 127	3, 126, 514	3, 234, 469	3, 304, 503
2, 608, 649	2, 830, 200	3, 027, 454	3, 128, 431	3, 234, 484	3, 305, 779
2, 626, 384	2, 833, 994	3, 027, 455	3, 129, 396	3, 247, 475	3, 306, 990
2, 637, 782	2, 883, 521	3, 039, 081	3, 131, 354	3, 250, 997	3, 307, 051
2, 650, 333	2, 834, 879	3, 041, 550	3, 149, 317	3, 250, 999	3, 307, 121
2, 688, 059	2, 888, 652	3, 048, 659	3, 162, 821	3, 252, 109	3, 322, 982
2, 691, 094	2, 899, 547	3, 048, 747	3, 175, 183	3, 256, 497	3, 333, 122
2, 691, 560	2, 901, 601	3, 059, 184	3, 175, 187	3, 263, 172	
2, 699, 425	2, 912, 573	3, 061, 785	3, 175, 193	3, 264, 576	
2, 705, 281	2, 918, 571	3, 070, 737	3, 183, 382	3, 273, 083	
2, 731, 555	2, 924, 705	3, 070, 748	3, 191, 123	3, 275, 938	

Other U.S. Patents Pending

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MOTOROLA

MODEL TABLE

TRANSISTORIZED

ALERT MONITOR FM RECEIVER

30-54 MC 117 V AC/12 V DC

CODE:

- [X] = ONE ITEM INCLUDED
- [2] = TWO ITEMS INCLUDED
- [/] = ONE ITEM INCLUDED WITH EVERY FIVE (OR LESS) RECEIVERS
- [4] = FOUR ITEMS INCLUDED
- [O] = ALTERNATE ITEM; CHOICE DEPENDENT ON FREQUENCY RANGE

MODEL NUMBER	DESCRIPTION	M01CNB-1100A	M01CNB-1101A	M01CNB-1102A	M01CNB-1103A	M01CNB-3100A	M01CNB-3105A
	DESCRIPTION	ALERT MONITOR FM RECEIVER (NOISE SQUELCH)	ALERT MONITOR FM RECEIVER (SINGLE-TONE DECODER)	ALERT MONITOR FM RECEIVER (TWO-TONE SEQUENTIAL DECODER)	ALERT MONITOR FM RECEIVER ("QUIK-CALL" DECODER)	ALERT MONITOR FM RECEIVER ("PRIVATE-LINE" DECODER)	ALERT MONITOR FM RECEIVER (TAMPER-PROOF "PRIVATE-LINE" DECODER)
NRB6152AB	RECEIVER CHASSIS (30-42 MC)	O	O	O	O	O	
NRB6153AB	RECEIVER CHASSIS (42-54 MC)	O	O	O	O	O	
NHN6162A	HOUSING AND PANEL KIT	X	X	X	X	X	
NLN6579A	ESCUTCHEON KIT (NOISE SQUELCH)	X					
NLN6580A	ESCUTCHEON KIT (SELECTIVE CALL)		X	X	X		
AN-95	RECEIVER CONTROL CRYSTAL (30-42 MC)	O	O	O	O	O	O
AN-96	RECEIVER CONTROL CRYSTAL (42-54 MC)	O	O	O	O	O	O
G19 OR G20	RECEIVER IF CRYSTAL	X	X	X	X	X	X
NLN1046A	SINGLE-TONE DECODER		X				
NLN6577A	"QUIK-CALL" DECODER				X		
NLN6578A	TWO-TONE SEQUENTIAL DECODER			X			
NKN6122A	AC POWER CABLE	X	X	X	X	X	X
TLN6709BG	"VIBRASPONDER" RESONANT REED			2	4		
NLN6598A	TUNING TOOL	/	/	/	/	/	/
NRB6162AB	RECEIVER CHASSIS						O
NRB6163AB	RECEIVER CHASSIS						O
NHN6178A	HOUSING AND PANEL KIT						X
NLN6646A	ESCUTCHEON KIT ("PRIVATE-LINE")					X	
NLN6647A	ESCUTCHEON KIT (TAMPER-PROOF "PRIVATE-LINE")						X
TLN8381A	"VIBRASPONDER" RESONANT REED					X	X
NLN6648A	"PRIVATE-LINE" DECODER					X	
NLN6649A	"PRIVATE-LINE" DECODER (TAMPER-PROOF)						X

EPD-18930-A

DESCRIPTION

1. INTRODUCTION

The Motorola Alert Monitor FM Receiver is a completely transistorized, dual conversion FM receiver for the 30-54 mc range. It is used for channel monitoring and personnel alerting applications for police, fire and other public safety departments, as well as Civil Defense, utility companies and other applications. The noise squelch model monitors all transmissions on the channel. Other models are available with selective signalling options for alerting functions.

The receiver operates from a 117-volt ac, 60-cycle or a nominal 12-volt dc, negative ground source. An emergency battery power supply is available for installation in the receiver for operation in case of power failure.

By interchanging the power cables, the receiver may be operated in a vehicle using the Model NKN6123A DC Power Cable, the Model NLN6588A Mobile Mounting Rack and the Model NKN6131A Adapter Cable (for connecting to an antenna mounted on the vehicle).

2. RECEIVER FEATURES

a. Standard Models

The basic receiver model is supplied with an ac power cord. An antenna receptacle is provided on the rear of the radio. The housing is equipped with a side-mounted handle for ease in carrying.

b. Selective Signalling Models

In addition to the previously-mentioned features, all selective signalling models include an indicator light on the front panel to show when an alert call has been received. Two-tone sequential and "Quik-Call" models also sound an audible tone when a correctly-coded signal is received. A reset switch, is used to restore the alert lamp and the receiver to its normal condition after a call.

Selective-signalling models may be used to receive all on-frequency transmissions by setting the ALERT-MON switch to the MON position.

c. "Private-Line" Models

The standard "Private-Line" model is equipped with a PL-OFF switch. When the switch is set to the PL position, the receiver will respond only to transmissions coded with the proper "Private-Line" tone. To hear all on-frequency transmissions, the switch is set to the OFF position.

The "tamper-proof" version is equipped with an A (Alert) light and a RESET switch. When the properly-coded "Private-Line" signal is received, the red A (Alert) light is illuminated to signal that a message intended for that radio has been transmitted. The light remains on until the RESET switch is pressed, which extinguishes the lamp until the next properly-coded signal is received.

3. OPTIONAL ACCESSORIES

The NLN1045A Emergency Battery Kit is an accessory item which may be installed in the receiver to keep it operating during a power failure. The kit contains a rechargeable nickel-cadmium battery with mounting hardware. The battery is recharged when the receiver is operated from an ac line or when the monitor is receiving power from a vehicle battery.

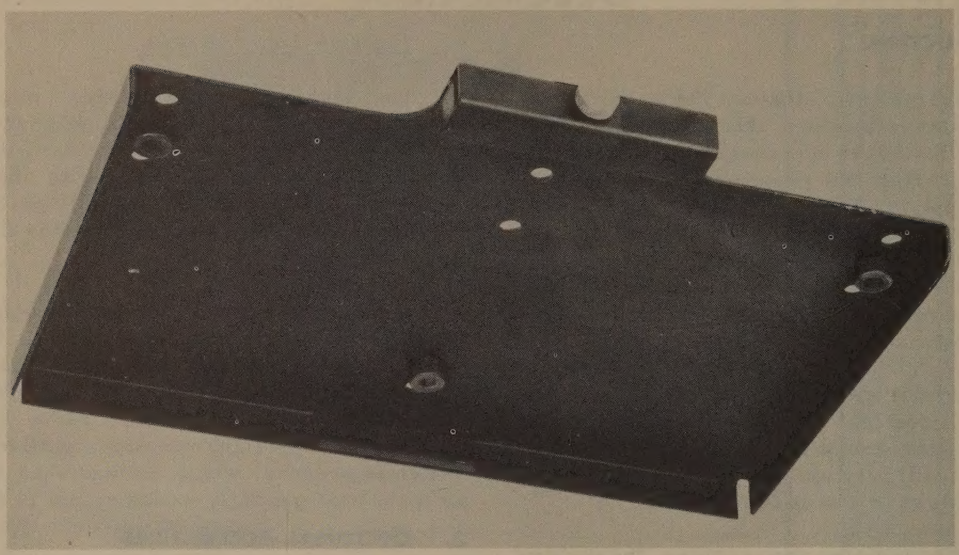
The NLN6633A Relay Switching Kit provides a contact closure upon receipt of an alert tone in selective calling models. This contact closure may be used to control external audible or visual signalling devices rated not more than 2 amperes at 117 volts ac with not more then 5 amperes maximum inrush current.

Other accessory items are available for a variety of installations. Refer to the following Accessory Table for a complete listing.

ACCESSORY TABLE

MODEL	DESCRIPTION
NLN1045A	Emer. Pwr. Supply and Charger Kit
NLN6588A	Mobile Mounting Rack
NAB6191A	Flexibile Wire Antenna 30-42 MC
NAB6192A	Flexible Wire Antenna 42-54 MC
NKN6123A	DC Power Cable
NKN6131A	Antenna Adapter Cable
TSN6005A	Aux. Spkr. Kit (less volume control)
TSN6006A	Aux. Spkr. Kit (with volume control)
NLN6633A	Relay Switching Kit

ACCESSORIES

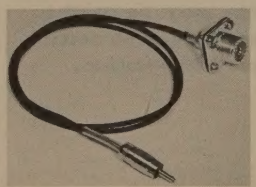


Model NLN6588A
Mobile Mounting Rack

Model TSN6005A (less volume control)
Model TSN6006A (w/volume control)
Auxiliary Speaker Kit

Model NLN1045A
Emergency Battery Kit

Model NKN6123A
DC Power Cable



Model NKN6131A
Antenna Adapter Cable

Models NAB6191A, 92A
Flexible Wire Antenna

4. SELECTIVE SIGNALLING SYSTEMS

a. Model NLN1046A Single-Tone Decoder Unit

This decoder unit adapts the Transistorized Alert Monitor FM Receivers for use in single-tone systems using a single-tone encoder at the transmitter and this decoder unit in the receiver. With these features, the transmitter may selectively call individual receivers or groups of receivers on the same r-f channel. The decoder will allow only signals with the proper tone code to be heard in the speaker when the ALERT-MON switch is in the ALERT position. Thus, only the receiver or receivers for whom the call was intended will receive the message.

b. Model NLN6578A Two-Tone Sequential Decoder Unit

With this decoder unit, any receiver (or receivers) with a given tone code in a system may be alerted by two selected tones in sequence emanating from the associated transmitter. Upon receipt of the proper sequence of tones, an audible alert tone is generated and an alert lamp is illuminated on the front panel.

The decoder consists of a printed circuit board containing the major circuitry and switches, alert light, and interconnecting cable to the main receiver chassis.

c. Model NLN6577A "Quik-Call" Decoder Unit

"Quik-Call" operation with the monitor receiver is possible when the Model NLN6577A Decoder Unit is installed. With this system, the associated transmitter can alert a specific unit or a group of units at will. A specific unit is alerted with an "individual call" tone code consisting of 2 pulses of 2 tones each, or several units may be alerted as a group with a "group call" tone code, consisting of 1 pulse of 2 tones. The complexity of the calling tone sequence insures small probability of false response to tone signals. An audible tone and a lamp signal the receipt of an alert message.

The decoder consists of a printed circuit board containing the major circuitry, switches, alert light, interconnecting cable to the main receiver chassis and "Vibrasponder" resonant reeds. The "Vibrasponder" reed passes an audio voltage, at its resonant frequency, which is used to trigger switching circuits. These reeds resonate at specific frequencies in the 346.7 to 1161.4 cycles per second range. For any given system, all "Vibrasponder" reeds used must be of the same series, i.e., "Z", "B" or "A". Refer to applicable portions of the THEORY OF OPERATION section.

5. "PRIVATE-LINE" SYSTEMS

a. "Private-Line" Tone-Coded Squelch Decoders

With these decoders, a receiver or group of receivers may be alerted with a "Private-Line" tone from an associated transmitter. Two types of "Private-Line" decoders are available.

b. Standard Versions

The Model NLN6648A Decoder provides a choice of full "Private-Line" operation, or conventional carrier squelch operation, selectable by a switch. When set for "Private-Line" operation, only messages with the sub-audible "Private-Line" tone will be heard. With the "PL" switch in the OFF position, all on-frequency messages will be heard.

c. "Tamperproof" Versions

The Model NLN6649A Decoder is available for "tamperproof" operation. With this decoder, the receiver will respond only to messages modulated with the sub-audible "Private-Line" tone intended for it. When a properly-coded message is received, the A (Alert) light will be illuminated. Pressing the RESET switch will extinguish the light until another properly coded signal is received.

INSTALLATION AND OPERATION

1. INSTALLATION

a. Inspection

Inspect the equipment thoroughly as soon as possible after delivery. If any part of the equipment has been damaged in transit, report the damage to the transportation company immediately.

b. Location

The equipment can be located on a desk top or other convenient surface. It should, however, be located near a primary power source and the antenna line connection (when an external antenna is used).

2. ANTENNA AND POWER CONNECTIONS

(Refer to Figure in the MAINTENANCE section of this manual.)

a. Antenna Connection

Insert the antenna connector of the Model NAB6191A, 92A Flexible Wire, the Model NKN6131A Antenna Adapter Cable, or of the feedline to an external antenna, into the ANT receptacle on the rear panel of the receiver. When the flexible wire antenna is connected directly to the receiver, extend the wire to full length, with as much of the wire length as possible in a vertical position.

NOTE

Plug must be fully seated into ANT receptacle for proper operation of the receiver.

b. Primary Power Connection

(1) AC Operation

Plug the Model NKN6122A AC Power Cable into the PWR receptacle on the back of the radio and into a 117-volt ac, 60-cycle single phase outlet.

(2) DC Operation

Connect the Model NKN6123A DC Power Cable to the PWR receptacle on the receiver when it is to be used in a vehicle. Be sure that the vehicle is equipped with a 12-volt, NEGATIVE GROUND ONLY electrical system before inserting the cable plug into the cigar lighter receptacle. Do not attempt to operate the radio on a positive ground electrical system.

c. External Speaker Connection

For external speaker operation, solder a phone plug (28A804790) to one end of a two-conductor cable (30B865857). Solder the other end of the two-conductor cable to the external speaker terminals. Insert the phone plug into the SPKR receptacle on the rear of the radio set. Be sure that the plug is firmly seated.

3. PRE-OPERATIONAL CHECKS AND ADJUSTMENTS

These checks and adjustments should be made before placing the receiver in service. They are necessary due to the possibility of mishandling in transit and the wide range of operating conditions. Refer to the performance checks in the MAINTENANCE section of this manual. If the readings are beyond the given limits, align the receiver as prescribed in the alignment procedure.

4. OPERATION

(Refer to Figure 1)

a. Receivers without Decoder Units

(1) Turn the power "on" by rotating the OFF-VOL control clockwise until a "click" is heard. When external power is applied to the radio, the blue P (power) lamp will light.

(2) Turn the SQUELCH control fully counter-clockwise.

(3) When a signal is received, adjust the OFF-VOL control to the desired level.

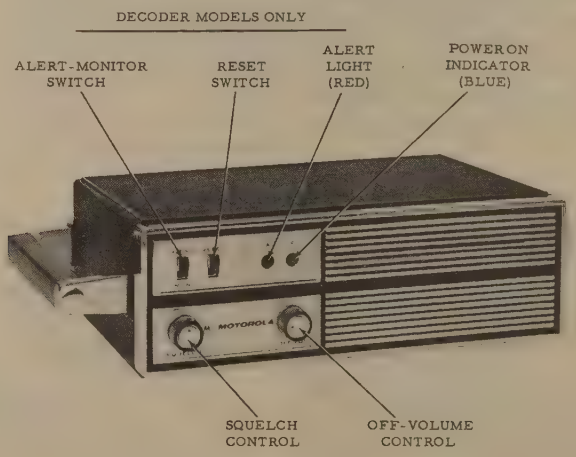


Figure 1.
Location of Operating Controls

(4) When no signal is being received, rotate the SQUELCH control clockwise until the background noise is just squelched (cut out). Turning the control past this point will decrease the sensitivity of the receiver, possibly causing some messages to be missed.

b. Receiver Models with Single-Tone, Two-Tone Sequential, and "Quik-Call" Decoder Units

When initially placing a single-tone decoder type unit in service, refer to the performance checks outlined in the MAINTENANCE section of this manual. The "Quik-Call" and two-tone sequential decoders require no special alignment.

After completing the initial installation procedures, perform the routine pre-operational adjustment procedure that follows.

(1) Set the ALERT-MON switch to the MON position.

(2) Turn the power "on" by rotating the OFF-VOL control clockwise until a click is heard. When external power is applied to the radio, the blue P (power) lamp will light.

(3) Turn the SQUELCH control fully counterclockwise.

(4) When a signal is received, adjust the OFF-VOL control to the desired level.

(5) When no signal is being received, rotate the SQUELCH control clockwise until the background noise is just squelched (cut out). Turning the control past this point will decrease the sensitivity of the receiver, possibly causing some of the messages to be missed.

(6) After the volume and squelch controls have been properly set, move the ALERT-MON switch to the ALERT position.

(7) Upon receipt of a properly tone-coded signal, the red A (alert) lamp will light. The receiver will unsquelch, and an alerting tone will be heard in two-tone sequential and "Quik-Call" models followed by the message.

(8) After the receiver is alerted, the unit will receive all on-frequency messages until the RESET switch is actuated momentarily. The receiver will then remain squelched until the next properly tone-coded signal is received.

CAUTION

Do not press the RESET switch while an alert tone or message is being received, or the message will not be heard. If the RESET switch is pressed during the tone or voice message, move the ALERT-MON switch to the MON switch to the MON position immediately to avoid missing the message.

(9) The A (alert) light may be tested by pressing the RESET switch. The lamp should remain lit as long as the switch is depressed.

c. Receiver Models with "Private-Line" Decoder Units

When initially placing a "Private-Line" decoder-type unit in service, refer to the performance checks outlined in the MAINTENANCE section of this manual. After the initial installation procedures have been carried out, the routine pre-operational procedures are as follows:

(1) Models with "PL" ON-OFF Switch

(a) Set the "PL" ON-OFF switch to the "PL" OFF position.

(b) Turn the power "on" by rotating the OFF-VOL control clockwise until a click is heard. When external power is applied to the radio, the blue P (power) lamp will light.

(c) Turn the SQUELCH control fully counterclockwise.

(d) When a signal is received, adjust the OFF-VOL control to the desired level.

(e) With no signal being received, rotate the SQUELCH control clockwise until the background noise is just squelched (cut out). Turning the control past this point will decrease the sensitivity of the receiver, possibly causing some of the messages to be missed.

(f) After the volume and squelch controls have been properly set, move the "PL" ON-OFF switch to the ON position.

(g) Upon receipt of a properly-coded "Private-Line" signal, the receiver will unsquelch for the duration of the message, allowing it to be heard. With the switch in the "PL" ON position, only messages with the proper "Private-Line" tone code will be heard.

(h) To hear all on-frequency messages, move the "PL" ON-OFF switch to the OFF position.

(2) Models with RESET Switch

(a) Turn the power "on" by rotating the OFF-VOL control clockwise until a click is heard. When external power is applied to the radio, the blue P (power) lamp will light.

(b) Press the RESET switch. The red A (alert) lamp will light while the switch is depressed. Release the switch. The receiver will remain quiet until a "Private-Line" tone-coded signal is received.

(c) Upon receipt of a correctly-coded "Private-Line" signal, the receiver will unmute, allowing the message to be heard. The red A (alert) lamp will light, and remain lit. Press the RESET switch to extinguish the lamp.

THEORY OF OPERATION

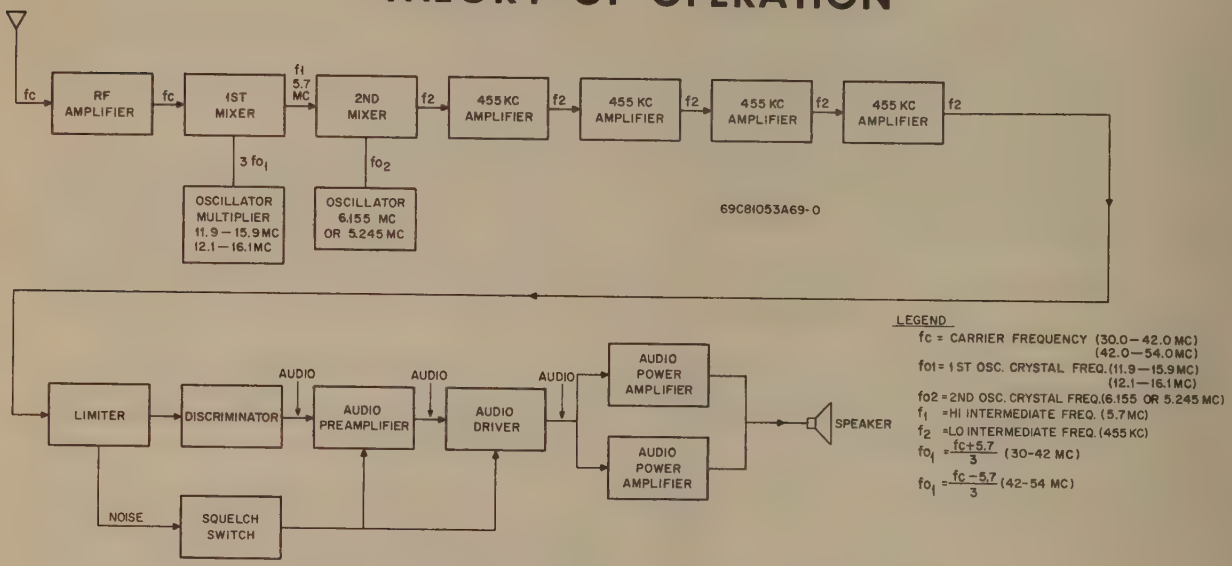


Figure 2. Receiver Block Diagram

1. BASIC RECEIVER

a. General

(Refer to Receiver Schematic Diagram.)

This receiver is an FM dual-conversion superheterodyne type and operates on a single, fixed, crystal-controlled frequency in the 30-54 mc range. The receiver consisting of rf and i-f stages, an oscillator, audio and squelch stages, power supply and regulator circuits, is contained on one printed circuit board. When used as a noise squelch receiver, it monitors all on-frequency transmissions. However, when selective signalling devices such as the single-tone, "Quik-Call" two-tone sequential and "PL" decoders are used, only messages for the specific unit are received.

b. RF Amplifier

Signals received at the antenna, pass through an antenna jack and are capacitively coupled through two inductively tuned circuits to the base of rf amplifier transistor Q1. The rf amplifier stage is an N-P-N common-emitter amplifier operating class A with a forward bias of approximately 0.7 volt. This stage amplifies the signal and improves the sensitivity and selectivity of the receiver. After amplification, the signal is again capacitively coupled through two inductively tuned circuits to the base of first mixer transistor Q2.

c. First Oscillator-Multiplier

First oscillator stage Q5 is a P-N-P transistor in a common-collector (emitter follower) configuration. This crystal-controlled stage is adjustable by a "warping" capacitor and operates over a frequency range of either 11.9-15.9 mc for a 30-42 mc channel frequency or 12.1-16.1 mc for a 42-54 mc channel frequency. As the stage operates class C, the output from the emitter is rich in harmonics. Coils L7 and L8 are used to tune the multiplier circuits to the third harmonic of the oscillator frequency. This signal from the

multipliers is then injected at the base of the first mixer along with the signal from the rf amplifier stage.

The first oscillator crystal frequency may be computed as follows:

30-42 MC:	42-54 MC:
$F_{o1} = \frac{F_c + 5.7 \text{ mc}}{3}$	$F_{o1} = \frac{F_c - 5.7 \text{ mc}}{3}$

Where: F_{o1} = 1st Oscillator Frequency
F_c = Carrier Frequency

d. First Mixer

Signals from both the rf amplifier stage and the first oscillator-multiplier stage are applied to the base of the mixer transistor Q2. These signals are heterodyned by the first mixer stage to produce a high i-f frequency (intermediate frequency) of 5.7 mc at the oscillator. This frequency is the difference between the rf signal and the signal from the first oscillator-multiplier stage. Four resonant circuits in the output of the first mixer provide selectivity at the 5.7 mc intermediate frequency. Signals from the last resonant circuit are capacitively coupled to the base of second mixer transistor Q3.

e. Second Oscillator

Crystal-controlled second oscillator Q6 uses an N-P-N transistor in a common-collector (emitter follower) configuration. The frequency of the second oscillator is either 6.155 mc or 5.245 mc which is 455 kc above or 455 kc below the high if frequency of 5.7 mc. This oscillator frequency is not adjustable. An output from the emitter of Q6 is applied to the base of second mixer transistor Q3 along with the intermediate frequency.

f. Second Mixer

Signals from the second oscillator are heterodyned with the intermediate frequency in second mixer stage Q3 to produce a frequency difference of 455 kc. This is the low i-f or second intermediate frequency. The second mixer is an N-P-N transistor arranged in a common emitter configuration.

g. 455 KC Filter

A lattice type 455 kc ceramic filter is between the output of second mixer stage Q3 and the input to the 455 kc i-f amplifier stages. This filter has a bandwidth of approximately 12 kc and determines the adjacent channel selectivity of the receiver.

The second i-f signal is coupled to the filter from the second mixer and is reduced to a low voltage by transformer T3. The signal then passes through resonators Y1 and Y2 to transformer T8 which increases the signal voltage. Transformers T3 and T8 are both resonant at 455 kc.

When the second i-f signal is exactly 455 kc, both Y1 and Y2 couple the same amount of signal to the output. When the signal is at the resonant frequency of a resonator (Y1 = 452 kc; Y2 = 458 kc) most of the signal is coupled to the output by that resonator and very little passes through the other resonator. Signals within approximately ±3 kc of the resonator frequency will easily pass through the filter.

Signals that are not close to 455 kc or the frequencies of the resonators will be greatly attenuated. These signals are rejected by the selectivity of tuned transformers T3 and T8 and by the balancing action of a bridge network (secondary of transformer T3 and resonators Y1 and Y2). The points of maximum rejection at which the bridge balances are controlled by capacitor C42.

The components of this filter are not encapsulated but are mounted individually on the printed circuit board. The filter is, therefore, serviceable since parts may be removed and replaced as necessary.

h. 455 KC IF Amplifiers

Signals from the output of the 455 kc filter are capacitively coupled to the base of first 455 kc i-f amplifier Q4. There are four 455 kc i-f amplifier stages. All stages (Q4, Q7, Q8 and Q9) use N-P-N transistors arranged as common-emitter amplifiers. Most of the gain of the receiver is contained in these amplifiers, with each stage having approximately 20 db of gain. Metering point J5-1, located in the base circuit of Q8 is used for alignment and is also used when making service measurements.

i. Limiter

Limiter stage Q10 follows the 455 kc intermediate frequency amplifier stages. This stage is basically the same as the 455 kc i-f amplifiers. Its function is to remove amplitude variations in the received signal, leaving only variations in frequency to be coupled to the discriminator.

NOTE

If the signal being received is of sufficient strength, the fourth 455 kc i-f amplifier will also appear to be reverse-biased and will, therefore, be producing a limiting action.

When Q10 receives an incoming signal of sufficient amplitude it starts to conduct. Once conducting, the limiter stage reaches the point ot saturation and stays saturated until the incoming signal again allows the transistor to be cut off. Thus, the limiter stage operates between saturation and cut-off and performs its function of removing amplitude variations from the received signal, leaving only variations in frequency to be coupled to the discriminator.

j. Discriminator

The discriminator diodes and associated circuitry translate the frequency variations of the 455 kc i-f signal from the limiter to the corresponding amplitude variations which represent the recovered audio modulation of the received signal. A tuned circuit, consisting of the secondary of T4 and capacitors C54 and C55, is adjusted for resonance at 455 kc. At resonance, equal voltages are applied to diode CR5 and CR6, producing a zero voltage at the output of the discriminator. As the incoming i-f signal varies in frequency (at an audio rate) above and below 455 kc, the resonant circuit appears capacitive or inductive and applies unequal voltages to diodes CR5 and CR6. This results in a negative voltage output under one condition and a positive voltage under the other condition. The output thus varies from positive to negative through zero and from negative to positive through zero at an audio rate. This varying output passes through the volume control and is applied to the audio preamplifier stage.

k. Audio Stages

(1) Audio Preamplifier Stage

Audio signals at the volume control are capacitively coupled to the base of audio preamplifier transistor Q11. The circuit uses an N-P-N transistor arranged in a common-collector (emitter follower) configuration. Signals are directly coupled from the emitter of Q11 to the base of audio driver transistor Q12. Control voltages from the squelch switch stage (Q17 and Q18) are applied to the emitter of audio preamplifier transistor Q11. These dc control voltages vary the emitter voltage of Q11 allowing the transistor to conduct during the reception of a signal or causing it to be cut off when a signal is not present. Refer to the squelch switch stages (paragraph l.) for a detailed explanation of the squelching of the audio stages.

(2) Audio Driver Stage

Audio signals from audio preamplifier stage Q11 are direct coupled to the base of the audio driver stage, Q12. The conduction of this stage, a P-N-P, common emitter amplifier, is controlled by its base voltage which, in turn, is controlled by the emitter voltage of audio preamplifier transistor Q11. When Q11 is conducting, audio driver transistor Q12 is also conducting. Signals on the base of this transistor are amplified and appear in the collector circuit of the stage where they are transformer coupled to the audio power amplifier stage.

(3) Audio Power Amplifier Stage

A push-pull power amplifier stage completes the audio section of the receiver. Signals are transformer coupled by transformer T5 from audio driver stage Q12 to the bases of P-N-P power amplifier transistors Q13 and Q14. CR7 and R57, connected to the emitters of Q13 and Q14 via R58, compensate for temperature variations. Capacitors C72 and C73 introduce negative feedback in the power amplifier stage to aid in reducing the amount of distortion in the audio stages. The audio power amplifier stage drives the loudspeaker via output transformer T6 at an audio level up to 2 watts. A jack (J2) is provided to connect an external 3.2 ohm speaker in series with the speaker in the unit.

l. Squelch Switch Stages

(1) Squelched Condition

Squelch switch stages Q17 and Q18 activate the audio stages during the time a signal is received and disable or mute the audio stages during the period no signals are present.

A portion of the noise present in the collector circuit of limiter stage Q10 (when no signal is being received) is coupled by capacitor C63 to squelch control R39. This control is in the base circuit of N-P-N squelch noise amplifier transistor Q17. With no noise input (or squelch control at minimum), the stage is cut off. As the noise input is increased (or the squelch control is turned to maximum), the dc base voltage goes negative which would appear to cut off transistor Q17 even more. However, the positive alternations

of noise are of sufficient amplitude to drive transistor Q17 into conduction. During the time that Q17 is conducting, its collector potential swings in a negative direction, approaching zero or ground potential. As the collector voltage of Q17 changes in a negative direction, a shift in base voltage at squelch switch transistor Q18 occurs. This shift of voltage in a negative direction forward biases the base-emitter junction of transistor Q18, turning on the transistor. This causes the collector potential of Q18 to approach the emitter voltage which is the supply voltage.

The positive change in voltage on the collector of Q18 is applied to the emitter of audio preamplifier stage Q11. The change is sufficient to make the emitter potential of Q11 more positive than the base voltage. Since Q11 is an N-P-N transistor, a reverse-bias condition now exists; audio preamplifier transistor Q11 is cut off and the audio stage is muted or squelched.

Audio driver stage Q12 will also be cut off or squelched since a change in emitter voltage of Q11 will also change the base voltage of Q12. Since the emitter of Q11 is direct coupled to the base of Q12, a positive voltage change on the emitter of Q11 produces a positive change in the base voltage of Q12. A reverse-bias condition now exists on P-N-P audio driver transistor Q12 and the stage is cut off or squelched. Thus the squelch stages control both the audio preamplifier stage and the audio driver stage.

(2) Unsquelched Condition

As a signal is received, the amount of noise present in limiter stage Q10 drops to a very low level. Only a 455 kc signal is present and the bottom of the primary of transformer T4 (in the collector circuit of Q10) is essentially at ground potential to a 455 kc signal. Thus, no signal is present at the input to the squelch switch stages. Transistor Q17 is cut off at this time and its collector is at its highest positive potential. With the collector voltage at its maximum positive voltage, the base of Q18 is also at its maximum positive potential which creates a reverse-bias condition for the base-emitter junction of transistor Q18. As Q18 is reverse-biased, its collector potential will swing in a negative direction. Since the emitter of audio preamplifier Q11 is directly coupled to the collector of Q18, the emitter potential of Q11 also swings in a negative direction. This creates a forward bias condition for Q11 and allows the incoming audio to be amplified. The changing voltage on the emitter of Q11 also causes a change in the base potential of Q12, allowing Q12 to become forward biased. Both the audio preamplifier and the audio driver are now forward biased or unsquelched.

m. Power Amplifier Squelch

In the absence of a received signal, the audio preamplifier and audio driver stages are cut off (squelched). Under this condition, no current is drawn through transistor Q12. With no current, there is no voltage drop across resistor R55 in the collector circuit of Q12 (resistor R55 is also in the base circuit of the power amplifier squelch transistor Q19). Since there is no voltage drop across resistor R55, the base of Q19 is at ground potential and the transistor is cut off. While the transistor is cut off, the voltage divider (of which Q19 is a portion) is essentially an open circuit. This prevents power amplifier transistors Q13 and Q14 from becoming forward biased since there is no complete path for current flow to establish the proper base voltages. Thus, the power amplifier stage is cut off, blocking any signal from reaching the speaker and minimizing the standby current drain. When a signal is received, current flows through audio driver transistor Q12 and consequently through resistor R55. At this time, there is a voltage drop across resistor R55, causing a forward-bias condition for power amplifier squelch transistor Q19, driving it into saturation. The collector of transistor Q19 is now at ground potential and the path for current flow in the power amplifier transistor base circuit is complete. A forward bias condition now exists for the power amplifier stage, allowing audio signals to reach the speaker.

2. POWER SUPPLY

a. General

The power supply provides A+ voltages for the receiver and the tone decoder boards (if used). The input to the power supply may be either from a 117 volt ac source or a 12 volt dc negative ground source. Power for the receiver may also be supplied by an internal 10 volt nickel-cadmium battery used primarily for emergency service. This internal power supply charges as long as external power is applied to the unit. If the external power source fails, the internal battery automatically supplies voltage to the receiver.

When either the 117 volt ac or the 12 volt dc primary power is used, a two-transistor series regulator circuit provides regulated voltages to

the receiver and the tone decoder boards. When the 10-volt emergency supply is furnishing power, the regulator circuit is not used. Power is supplied directly to the receiver and the tone decoder boards.

b. Input Circuit

(1) AC Operation

The primary power input receptacle accepts an input cable from either a 117 volt ac or 12 volt dc source. The receptacle is keyed to prevent wrong insertion of the plug. When the input is from the 117 volt ac source, power is applied to pins 2 and 3 of receptacle J4. These pins are fused and connect to the primary of a step-down transformer T7. Approximately 20 volts ac is present across the secondary of transformer T7 when power is applied. Diode CR1 provides half-wave rectification of the ac voltage, producing a dc voltage which is applied through switch contact S1-A to a filter network and to the series regulator circuit.

(2) DC Operation

When the power input is from an external dc source, power is applied to pins 1 and 4 of receptacle J4. Pin 4 is connected to ground and pin 1 ties directly to switch contact S1-A. Thus, the dc input is applied directly to the series regulator circuit which, in turn, supplies the voltages for the receiver and tone decoder boards.

c. Regulator Circuit

The input to the regulator circuit is a dc voltage (from either the ac source via rectification or directly from the dc source). Following the filter circuit, a network consisting of resistor R29 and a nominal 13.25 volt zener diode (CR2) is used to establish a reference voltage for the base of control transistor Q16. The emitter of Q16 senses any change in the load on the output of the regulator circuit. (A change in loading produces a slight change in emitter voltage.) Since the base voltage is fixed by zener diode CR2, a change in bias of transistor Q16 occurs which changes the conduction of the transistor. A change in conduction causes a change in collector voltage and a change in the base voltage of series regulator transistor Q15. Again, the change in base voltage affects the bias of transistor Q15, controlling conduction and determining the voltage drop across the transistor and the output voltage from the regulator circuit. Thus, changes in output voltage of the regulator are sensed and compensated for by increasing and decreasing the conduction of (and the voltage drop across) transistor Q15.

3. SINGLE-TONE DECODER UNIT

(Refer to Single-Tone Decoder Schematic Diagram)

a. General

The single-tone decoder consists of an emitter follower stage, a tone amplifier, a tuned LC circuit followed by an emitter follower stage, a second tone amplifier, a two-transistor detector and timing circuit, a lock-up network, a control transistor, a switching transistor, and a squelch control circuit. Provision is also made for activating an optional relay switching kit. The decoder connects to the receiver through a five-conductor cable.

b. Operation with On-Frequency Tone

When a signal modulated by the proper single-tone frequency is received, a portion of the recovered audio is applied to the single-tone decoder via P1-4. This signal is coupled to the N-P-N emitter-follower stage Q101 which provides a high input impedance to prevent discriminator loading. From the emitter of Q101, the signal is coupled to N-P-N tone amplifier stage Q102. In the collector circuit of Q102, a tuned LC circuit (L101-C114) exhibits resonance and presents a high impedance to the desired tone signal. The signal developed across this high impedance is coupled to second emitter-follower stage Q103. This stage effectively isolates the tuned LC circuit from undesirable loading effects of the subsequent stages. The output from Q103 is applied to second tone amplifier stage Q104. In the emitter circuit of Q103, DRIVE ADJUST potentiometer R109 adjusts the amplitude of the signal. This determines the dynamic bandwidth capability of the decoder.

After being amplified by second tone amplifier stage Q104, the signal is coupled to a circuit consisting of transistors Q105, Q106 and associated components. This circuit, designated a tone switch, is a detector and timing circuit. The tone switch circuit provides protection against falsing (undesired triggering of the alarm circuit) by requiring the selective calling tone to be present for a duration longer than that of a normal voice peak or noise pulse.

When a positive-going signal is present at the input of transistor Q105, the normally cut off transistor starts to conduct. The collector voltage of Q105 decreases toward ground potential at a rate proportional to the magnitude of the signal at the base. The collector voltage is prevented from going immediately to ground

potential by the charging of capacitor C107. As the collector voltage of Q105 decreases, the voltage at the base of Q106 decreases, but at a slower rate due to the integration time of resistor R116 and capacitor C108. If the proper tone is present for the correct duration, the base potential of Q106 falls below that of its emitter, and the transistor conducts. If the tone duration is too short, the base voltage at Q106 does not drop to a low enough potential to saturate Q106.

Diode CR101 is used to keep capacitor C108 discharged when the alert monitor receiver is first turned on. This permits a fast recovery time for the circuit to prevent A+ falsing.

Q106 conducts until the tone ends, causing its collector potential to swing in the positive direction. This positive-going voltage from the collector of Q106 is applied to the ancde of diode CR102, forward biasing the diode. With diode CR102 forward biased, the base potential of transistor Q108 moves in a positive direction, causing a forward bias condition to exist at the base-emitter junction of Q108.

With transistor Q108 conducting, its collector voltage changes in the negative direction. Since the base of Q109 is directly coupled to the collector of Q108, the base voltage of Q109 will also change in a negative direction causing Q109 to conduct.

When Q109 conducts, its collector voltage is approximately equal to the A+ voltage. This rise in collector voltage causes current to flow through resistor R128 and lamp DS101. As this occurs, the visual indicator A (red alert lamp) illuminates indicating that an alert signal has been received.

At the same time, the positive voltage existing at the collector of Q109 is applied to the base of transistor Q107. A forward bias condition is established for Q107 and the transistor saturates. The collector voltage of Q107 is now at ground potential. This places a ground at J1-3 via P1-3 on the receiver board, completing the squelch switch stage circuit path which turns the audio stage on.

The A+ voltage at the collector of Q109 is also applied to the base of Q108. This keeps Q108 conducting which, in turn, maintains Q109 and Q107 in conduction. Therefore, once alerted, the visual indicator A (red alert lamp) lights and the receiver audio stages are turned on. The unit now receives all messages until RESET switch S102 is operated. The RESET switch is a manually operated spring return type which, when placed in the reset (up) position, disconnects the emitter circuit of Q109. This removes the lock-up voltage which was fed back to the base of Q108. When the switch is released, the stages which were held "on", return to their quescent state. The receiver also returns to its quescent state and is ready to be activated by the next single-tone encoded transmission. The collector voltage of Q109 is also applied to P1-1 which activates the relay switching kit (if used) when the decoder is activated.

The decoder is also operative when the ALERT-MON switch, S101, is placed in the MON position. However, all messages, tone-coded or not, will be heard.

c. Operation with an Off-Frequency Tone

The received signal proceeds through the first two stages of the decoder in the same manner as an on-frequency tone. However, once the signal reaches the tuned circuit (L101-C111) a low impedance to ground is presented to the off-frequency tone. Therefore, no signal is coupled to the subsequent stages. The receiver audio circuit remains unactivated.

4. TWO-TONE SEQUENTIAL DECODER UNIT

(Refer to Two-Tone Sequential Decoder Schematic Diagram)

a. General

The two-tone sequential decoder consists of tone amplifiers, followed by two separate but similar tone channels. These channels, when activated in the proper sequence, activate a tone oscillator, block audio during the alerting period, and establish a path for the squelch switch stages. An output from the decoder board is also made available to activate the optional relay switching kit (if used). The decoder connects to the receiver through a seven-conductor cable.

b. Circuit Operation

When a signal modulated with the proper sequential tones is received, an output from the discriminator is applied to the decoder via connector P1-4. This signal at connector P1-4 is coupled to the base of Q302, an emitter-follower stage. This arrangement provides a high impedance input and prevents loading of the discriminator by the decoder circuit. From the emitter of Q302, the signals are coupled to reed driver Q303 for amplification. The collector output of Q303 is applied to the "Vibrasponder" resonant reeds.

Each reed is activated by a particular tone code. These tones, designated A (first tone) and B (second tone), must arrive in the proper sequence to provide the alert tone at the speaker. Tone A is transmitted for 1 second, followed within 300 milliseconds by 3 seconds of tone B.

The "vibrasponder" resonant reeds used are of the two coil, single-tine type. If a tone, equal in frequency to that of the mechanical resonance of the "vibrasponder" reed, is applied, the reed will vibrate strongly, acting as the electro-mechanical coupling device between the input and output coils. Therefore, each reed can be considered to be a very narrow bandpass filter which passes only the desired paging tone. Diode CR302 in the collector circuit of transistor Q303 is effectively in parallel with the input coils of both "vibrasponder" reeds. This diode limits the peak amplitude of the input signal to 0.2 volt maximum to ensure a constant input to the reeds. Also, the possibility of falsing is decreased by limiting any voice and noise peaks that may be coupled to the reeds when a signal is being received.

When tone A is received, it is passed through "vibrasponder" reed "A" and capacitively coupled to the base of reed amplifier Q305. The tone is amplified and coupled from the collector of Q305 through C310 to the base of Q308. Transistors Q308 and Q310 form a trigger circuit and are both normally cut off. When an input is received at the base of Q308, the transistor begins to conduct and its collector goes negative (i.e., less positive). This transition is coupled through R320 to the base of Q310, causing it to conduct and its collector to go in a positive direction. Resistor R320 and capacitor C313 in the base circuit of Q310 introduce some integration time for protection against false response. The positive transition at the collector of Q310 is coupled through R317 back to the base of Q308, increasing its forward bias and causing greater conduction. The positive potential at the collector of Q310 forward biases CR305 allowing it to conduct and couple a positive potential to the collector of Q314. Capacitor C316 acts as a filter, keeping the positive dc potential at the anode of CR305 relatively constant during the positive and negative going alternations of tone A transmission.

Q314 and Q317 form a basic monostable multivibrator circuit, with Q314 normally cut off and Q317 conducting (saturated). Figure 3 illustrates the waveforms at various points in the multivibrator and clamp circuits during the "on" and "off" periods of tone A and the start of tone B transmission. Prior to conduction of CR305, the potential at the collector of Q314 is approximately 1.3 volts dc, which is established by the resistive divider network consisting of R334 and R335. This voltage is fed through R329 to the base of transistor Q312, the clamp stage, providing forward bias for the transistor and allowing it to conduct to saturation. The path of conduction for Q312 is from ground through resistor R327, the transistor Q312, and resistors R306 and R307 in the base-collector circuit of Q304 to the B+ supply. The base of Q304 is effectively clamped to approximately zero volts (through transistor Q312), thereby cutting off the transistor. With Q304 cut off, the trigger circuit (consisting of Q307 and Q309) cannot operate which, in turn, keeps the tone oscillator (Q316 and Q313) deactivated. Since the tone oscillator is deactivated until tones A and B arrive in proper sequence, false alerting is prevented.

When CR305 conducts, the voltage at the collector of Q310 is coupled to the collector of Q314, increasing its potential to 3.6 volts dc (shown as waveform B in Figure 3). As noted previously, Q317 is normally conducting, and remains conducting, throughout the increase in potential at the collector of Q314. A forward bias of 0.6 volt dc is established at the base of Q317 through its emitter-base junction and R340. With the potential at the collector of Q314 at 3.6 volts and the base of Q317 at 0.6 volt dc, the effective potential across C318 increases from its normal value of 0.7 volts to 3.0 volts dc. (See waveform D in Figure 3.)

NOTE

The normal value of 0.7 volt dc across C318 results from the difference between the collector potential of Q314 (1.3 v dc) and the base potential of Q317 (0.6 v dc).

The multivibrator will remain in this state for the remainder of tone A transmission and the time period shown as "X" on the waveform detail (time "X" is the period required for the "vibrasponder" reed to stop vibrating once tone A has stopped). At the end of time period "X", the trigger circuit (Q308 and Q310) will revert to its former condition (i.e., both transistors cut off). The collector of Q310 will return to zero and CR305 will again be back-biased, cutting the diode off. When this occurs, the collector of Q314 tends to return to 1.3 volts, thus generating a negative going transition which is coupled through C318 to the base of Q317, cutting it off. The collector of Q317 now approaches the 3.6 volt dc supply potential. This positive transition is fed through

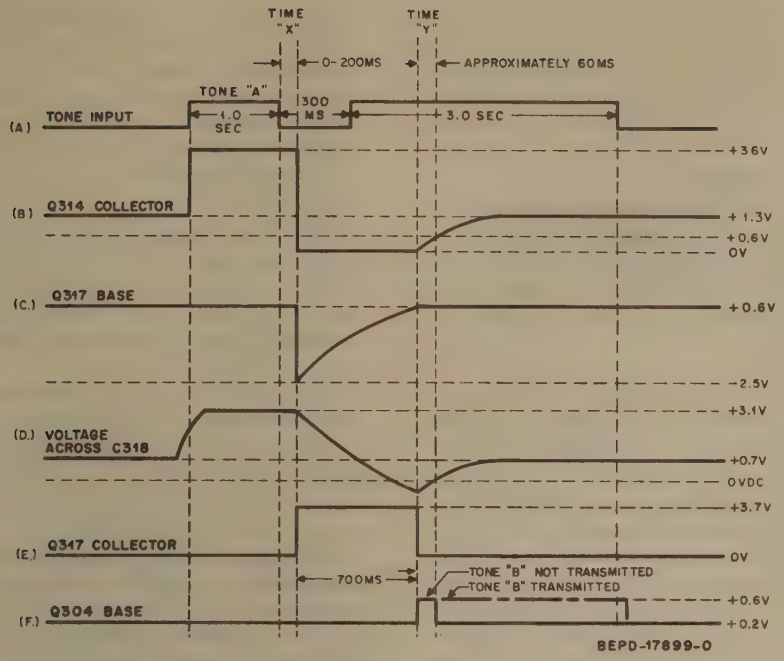


Figure 3.
Waveform Detail

R330 to the base of Q312, sustaining the forward bias previously established through R320 and keeping the transistor conducting. This will, as previously described, disable amplifier Q304, trigger circuit Q307 and Q309, and tone oscillator Q313 and Q316. The positive transition at the collector of Q317 is also coupled through R331 to the base of Q314 driving it into saturation. The positive transition at the collector of Q317 is also coupled through R331 to the base of Q314 driving it into saturation. The collector of Q314 will approach zero potential. C318 now begins to discharge, then slightly reverse charges through Q314 and R340. When the voltage reaches 0.6 volt, Q317 will again conduct, the collector will return to zero potential, and Q314 will be cut off. The collector of Q314 will now attempt to return to its normal cut off potential of 1.3 volts. However, due to the charging of C318, this action is not accomplished instantaneously. Therefore, with the collector of Q317 at zero and the collector of Q314 in transition from zero potential, a short period of time exists (shown as time "Y" on the waveforms in Figure 3) when there is no positive forward bias applied to Q312, the clamp stage. In this time period, Q312 will be cut off and amplifier Q304 will conduct (see waveform F in Figure 3).

At this time, tone B will be applied to the decoder, amplified by the tone amplifiers, and will pass through "vibrasponder" B to the base of Q304. Operation of amplifier Q304 and trigger circuit Q307 and Q309 is essentially the same as previously described for amplifier Q305 and the trigger circuit consisting of Q308 and Q310. However, as Q309 conducts, its collector goes positive, applying reverse bias to the emitter-base junction of Q312 (the clamp stage), sustaining its cut off condition and permitting Q304 and the succeeding stages to continue functioning throughout the duration of tone B transmission. The positive pulse from the collector of Q309 activates several circuits. When the collector of Q309 goes positive, diode CR304 becomes forward biased causing the base of Q311 to go positive. Bistable transistors Q311 and Q315 are used to illuminate the "A" visual indicator. This circuit is slightly different from the normal bistable circuit in that transistor Q311 is an N-P-N transistor while transistor Q315 is a P-N-P. This means that both transistors will be "on" at the same time and "off" at the same time. When the bias of Q311 goes positive, the transistor will turn on and its collector potential will move in a negative direction. The negative change in voltage is directly coupled to the base of Q315, causing

Q315 to turn on and saturate. As Q315 saturates, the collector potential goes positive and approaches the supply voltage (from the emitter of Q315). The supply voltage is not applied to the alert light and the light turns on.

NOTE

Once the decoder has been activated, voltages for bistable transistors Q311 and Q315, and the squelch switch control transistor Q306 remain in their activated condition until manually reset by the reset switch.

Transistor Q315 also provides a positive voltage to connector P1-1 to activate the relay switching kit when the decoder is alerted.

The positive change in the collector potential of Q315 is also applied through resistor R314 to the base of Q306, the squelch switch control transistor. Transistor Q306 will, in turn, saturate causing its collector to go to ground potential. With the collector at ground potential, P1-3 applies a ground to J1-3. With a ground at J1-3, the circuit for the squelch switch stages is completed. Since a signal is being received at this time, the squelch switch stage will be in an unsquelched condition, which turns on the audio circuit by forward biasing the audio preamplifier, audio driver, and power amplifier transistors.

As the collector of Q309 goes positive, power is applied to the collectors of transistors Q313 and Q316. Transistors Q313 and Q316 form an alert tone oscillator stage which oscillates at approximately 2000 cps. The oscillator is a very stable circuit using two transistors arranged as a common-collector (emitter-follower) stage driving a common-emitter stage and a parallel "Twin-T" RC network. A phase shift of 180° is achieved across the common-emitter transistor Q316 and an additional 180° phase shift occurs across the "Twin-T" network. The output of this network is applied as positive feedback to the input of common-collector stage Q313 to sustain oscillations. The alert tone is coupled through C321 to one of three voltage divider networks. The voltage divider network is selected by jumper JU1 being placed to J1 for a high level of 2 watts, to J2 for a medium level of 500 milliwatts, or to J3 for a low level of 50 milliwatts. The alert tone signal from the voltage divider network appears at P1-6, J1-6 on the receiver board, and finally at the input to the audio preamplifier where it is amplified and coupled through the remaining audio stages to the speaker.

Transistor Q318, an audio mute stage, is also controlled by the output of transistor Q309. As Q309 saturates, the positive going voltage on its collector is coupled through resistor R336 to the base of Q318. Since Q318 is a P-N-P transistor, the positive-going voltage on its base cuts it off. In the receiver, the audio path is from the volume control to J1-7, through the cabling to P1-7 on the decoder board, through C324 and Q318 to P1-6 and through the cabling to J1-6 and the audio stages of the receiver. With Q318 cut off and the audio path blocked, tone B is prevented from reaching the speaker during the time that the alert tone is generated. After tone B stops, Q318 again conducts, again establishing the audio path.

During the reception of tone B, the multivibrator circuit will return to its former state (Q314 cut off, Q317 conducting). The collector of Q314 will go positive, applying a positive potential to the base of clamp stage Q312. However, the reverse bias condition established by the conduction of Q309 exceeds the positive base potential and the clamp stage is kept in its cut off state for the remainder of the tone B transmission. At the end of the tone B transmission, the clamp stage will again conduct, cutting amplifier Q304 off and deactivating the trigger and tone oscillator circuits.

The visual indicator "A" stays illuminated until the RESET switch is momentarily actuated. When this occurs, bistable transistors Q311 and Q315 revert to their quiescent state. Consequently, Q306 is cut off, deactivating the noise squelch gate and muting the audio stages. The receiver may be activated again by the correct two sequential tones.

NOTE

The alert tone will be heard if the signal is repeated even if the unit has not been reset.

c. Monitor Selection and Tone Identification

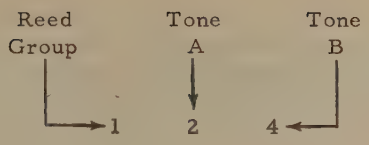
(1) Monitor Selection

In systems using a pushbutton control console (or more than one console), the operator selects the console corresponding to the first digit of the monitor code and then pushes the buttons corresponding to the second and third digits of the code.

In dial control systems with a capacity of 90 monitors or less, the second and third digits of the code are dialed to alert the monitor. In dial control systems employing more than 90 monitors, the complete 3 digit code must be dialed.

(2) Tone Identification

The three-digit monitor code identifies a specific reed group assigned to the alert monitor receiver and the two tone frequencies (A and B) used for the alerting circuit. The first digit identifies the reed group. The second and third digits determine tone frequencies A and B used in that particular group. For example, in systems employing pushbutton consoles, only the four reed groups listed in Chart A are used. Using Chart A and assuming that the monitor code is 124, the reed group is determined by correlating the first digit of the monitor code (1) to the reed groups listed in Chart A. For monitor code 124, the reed group assigned to the alert monitor would be reed group 1. The frequency tones A and B used within this group are determined in a similar manner except that the Tone Code column of Chart A is used to correlate the second and third digits of the monitor code. The second digit of the code (2) is Reed Code 112 with a frequency of 368.5 cps (under the Reed Group 1 column) and the third digit is Reed Code 114 with a frequency of 410.8 cps.



In dial control systems, combinations of the four reed groups are used in addition to the standard four groups to obtain additional call capacity. To identify the tones used in these systems, proceed as follows:

Assume the monitor code is 324. Locate first digit (3) in Chart B under the heading Code Group. In the second and third columns of this chart are the digits 1 and 2. These digits identify the reed groups (see Chart A) from which Tone A and Tone B were selected. In the above example, Tone A is the second tone in Reed Group 1 (reed 112) which is 368.5 cps. Tone B is the fourth tone in Reed Group 2 (reed 124) which is 707.3 cps. This method may be used to determine the tone frequencies of the monitor.

CHART A

Tone Number	Reed Group 1		Reed Group 2		Reed Group 4		Reed Group 5	
	Reed Code	Freq.	Reed Code	Freq.	Reed Code	Freq.	Reed Code	Freq.
1	111	349.0	121	600.9	141	339.6	151	584.8
2	112	368.5	122	634.5	142	358.6	152	617.4
3	113	389.0	123	669.9	143	378.6	153	651.9
4	114	410.8	124	707.3	144	399.8	154	688.3
5	115	433.7	125	746.8	145	422.1	155	726.8
6	116	457.9	126	788.5	146	445.7	156	767.4
7	117	483.5	127	832.5	147	470.5	157	810.2
8	118	510.5	128	879.0	148	496.8	158	855.5
9	119	539.0	129	928.1	149	524.6	159	903.2
0	110	330.5	120	569.1	140	321.7	150	553.9

CHART B

Code Group	Reed Group From Which Tone A is Selected	Reed Group From Which Tone B is Selected
1	1	1
2	2	2
3	1	2
4	4	4
5	5	5
6	2	1
7	4	5
8	5	4
9	2	4
0	4	2

CHART C

Reed No.	Freq.
109	313.0
130	979.0
131	1034.7
139	304.7
160	953.7
161	1006.0
162	1063.2

Early versions of Motorola selective calling control equipment used a code consisting of four digits. To make this equipment compatible with two-tone sequential monitors, simply drop the third digit. Example: Code 2527 uses the same reed coding as code 257 and contains reeds 125 and 127. When the third digit is dropped the tones used can be determined by the method outlined in the previous paragraphs.

Chart C lists seven additional reeds which can be used in spare monitors used with dial control systems. The code of a spare monitor will have the same second and third digits (e.g., 322). The frequency of Tone A is determined by the method described previously. However, Tone A is selected from the seven frequencies listed in Chart C. The frequency of Tone A is determined by the available tone and is assigned by Motorola to the system.

5. "QUIK-CALL" DECODER UNIT

(Refer to "Quik-Call" Decoder Schematic Diagram)

a. General

The "Quik-Call" decoder is a selective signalling device that responds to the proper arrangement of four individual tones for individual call operation. The four tones are arranged in two groups with two tones assigned to each group. Each tone has its own tone circuit, and when the proper sequence and tones are received a control circuit is activated. The control circuit illuminates the visual indicator A (red alert lamp), controls the squelch switch stages in the receiver, and activates the alert tone oscillator. The decoder can also be used for group call operation. In this case, a single pulse of two simultaneous tones initiates the same functions as for the individual call operation. The decoder connects to the receiver through a seven-conductor cable.

b. Individual Call Operation

When a signal, modulated by the proper audio tone frequencies, is received at the receiver, the recovered audio tones at the receiver discriminator are applied via J1-4 and the intercabling to P1-4. The tones are then coupled to the base of transistor Q200, an N-P-N emitter follower stage. This stage provides a high impedance input and isolates the decoder to prevent loading of the discriminator.

An output from the emitter of Q200 is direct coupled to the base of transistor Q201, a P-N-P tone amplifier stage. The tone signals are amplified and appear across the collector loads of Q201 which consists of the input coils of all four "Vibrasponder" reeds in series. When a tone corresponding to the resonant frequency of a "Vibrasponder" reed is applied to its input, that particular reed will pass the frequency to its output coil.

Transistors Q202, Q210, Q213 and Q215 are tone amplifiers operated class "A" and amplify outputs from respective reeds. Tones 1 and 2 are received first and appear simultaneously at the inputs to "Vibrasponder" reeds. The outputs from "Vibrasponder" reeds 1 and 2 are coupled to the bases of tone amplifiers Q210 and Q202, respectively. The amplified signals are coupled by capacitors C211 and C205 to the bases of transistors Q211 and Q203 respectively. Q211 and Q203 are both driven into saturation by the incoming tone signal. This completes the collector circuit of Q211 to ground. The emitter circuit of Q203, which is directly connected to the collector of Q211, is also completed to ground. With Q203 saturated, its collector voltage approaches ground potential. As this occurs, the base of Q204 also moves in a negative direction causing a forward bias condition to be established for the base-emitter junction of Q204, which turns on and saturates. When this occurs, the collector voltage of Q204 swings positive to nearly the A+ potential. As the collector voltage of Q204 goes positive, capacitor C207 charges to the A+ potential and the base of transistor Q205 swings positive. This would normally forward bias Q205 and cause it to turn on. However, during this sequence there is no ground return path for the emitter of Q205 and the transistor remains inactive. The conditions just described remain as long as tones 1 and 2 are present.

When tones 1 and 2 cease, all circuits revert to the standby status except the base voltage of transistor Q205 which remains positive due to the charge on capacitor C207. As soon as tones 1 and 2 cease and transistor Q204 turns off, capacitor C207 starts to discharge and the voltage at the base of Q205 begins to decrease toward ground potential. For the decoder to be activated, tones 3 and 4 must be received before the base voltage of Q205 decreases to a level inadequate for the turn-on of Q205.

Tones 3 and 4 are received approximately 0.2 second after tones 1 and 2. These tones are

coupled through J1-4 and the intercabling to P1-4 on the decoder and to Q200 which, in turn, feeds a signal to Q201. Transistor Q201 amplifies the signals which appear across the inputs to "Vibrasponder" tone reeds 3 and 4. The outputs produced by these reeds are amplified by transistors Q215 and Q213, and are coupled by capacitors C217 and C214 to transistors Q216 and Q214, respectively. The latter two stages are saturated by the signals causing the collector potential of Q214 to decrease to near ground potential. With the collector of Q214 at ground potential, diode CR202 becomes forward biased, placing the emitter of Q205 at ground. Diode CR202 prevents the A+ potential from being applied to the emitter of Q205 during standby so that excessive reverse bias will not damage the transistor. Since capacitor C207 has not completely discharged, the base of Q205 is still positive causing transistor Q205 to saturate. As soon as transistor Q205 saturates, its collector potential decreases toward ground potential, causing the base of transistor Q206 to swing in the negative direction. The P-N-P transistor (Q206) starts to conduct which, in turn, applies a forward bias to diode CR206. With diode CR206 forward biased, a positive pulse is applied to bistable, transistors Q207 and Q208.

NOTE

Once diode CR206 is forward biased by the positive voltage at the collector of Q206, all voltages established beyond the cathode side of the diode are alert voltage readings. These voltage readings are maintained until the RESET switch is activated. This condition exists because diode CR206 is reverse biased by the bistable, thereby preventing current flow from the bistable to ground via resistor R215.

As the positive pulse from diode CR206 is applied to the base of transistor Q207, the base-emitter junction becomes forward biased and the transistor turns on. The collector voltage of Q207 decreases to ground potential, causing the base voltage of Q208 to swing in a negative direction. Q208, a P-N-P transistor, is forward biased by the negative going voltage on its base. When Q208 conducts, its collector voltage is applied through resistor R221 as positive feedback to the base of Q207, keeping Q207 conducting. With Q207 conducting, the bistable (Q207 and Q208) is held to its present state (locked in).

The positive potential at the collector of Q208 is also applied to diode CR201. Diode CR201 becomes forward biased and allows a positive voltage to be applied to resistor R222 and lamp DS200. At this time, the lamp turns on and remains on until the circuit is manually reset by the RESET switch. CR201 prevents the A+ potential from being applied to the collector of Q208 during manual reset. If A+ were to reach this point, the alert tone oscillator would be activated.

At the same time, the positive voltage from the collector of Q208 is applied through diode CR201 and resistor R224 to the base of transistor Q209, forward biasing the transistor and turning it on. As Q209 conducts, its collector voltage decreases to ground potential. The ground potential via P1-3, the intercabling, and J1-3 completes the circuit for the squelch switch stages of the receiver. Since a signal is being received, the squelch switch stages now activate the audio stages. Transistor Q208 also provides a positive voltage through diode CR201 to P1-1 to activate the relay switching kit when the decoder is alerted.

A final output from transistor Q208 (point C on the digram) applies a positive voltage to the alert tone oscillator (Q219 and Q220) and to alert tone timing transistor Q218. The oscillator is a very stable "Twin-T" circuit using two transistors arranged as a common-collector or emitter-follower stage driving a common-emitter stage and a parallel "Twin-T" RC network. A phase shift of 180° is achieved across common-emitter transistor Q220 (no phase shift across the emitter-follower stage) and an additional 180° phase shift occurs across the "Twin-T" network. The output of the network is applied as positive feedback to the base of the common-collector stage to sustain oscillations.

Once voltage has been applied to the collectors of the transistors, an alert tone is applied from the collector of Q219 through resistors R250 and R251 to P1-6, through the intercabling to J1-6 and then to the audio stages where it is amplified and applied to the speaker. Three levels of tone output are available by connecting JU1 to J1 for a 2-watt output, or to J2 for a 500-milliwatt output, or to J3 for a 50-milliwatt output.

While the alert tone oscillator is operating, the paging tones are blocked from reaching the receiver audio stages by blocking diode CR205.

The path for receiver audio is from the volume control to J1-7, through the intercabling to P1-7, through capacitor C228 and diode CR205 to P1-6 through the intercabling to J1-6, and into

the input of the audio preamplifier stage. As voltage is applied to the alert tone oscillator a voltage is applied through resistors R250 and R251 to the cathode of diode CR205, making the cathode more positive than the anode. Thus, the diode is reverse biased and the receiver audio path is effectively open.

The alert tone oscillator is on for approximately three seconds. This is controlled by alert tone timing transistor Q218. When voltage is applied to point C from the collector of Q208, the alert tone oscillator immediately starts oscillating. However, alert tone timing transistor Q218 does not start to conduct due to capacitor C222 in its base circuit. When the voltage from point C is first applied, C222 is effectively a short circuit to ground keeping Q218 cut off. The capacitor will start to charge through R242. After approximately three seconds, the charge of C222 is sufficient to forward bias the base-emitter junction of Q218 causing it to conduct. The collector voltage of Q218 decreases to ground potential, removing the voltage applied to the alert tone oscillator. At this time, the alert tone oscillator will cease operating and CR205 again becomes forward biased. The conditions that now exist remain until the RESET switch is operated. Diode CR204 provides a fast discharge path for capacitor C222 after the voltage has been removed, setting up the decoder for the next alerting signal.

Transistor Q212 provides protection against falsing (response to an improper combination of tones) if the tones are presented in the reverse order. If tones 3 and 4 appear before tones 1 and 2, the reception of tones 3 and 4 causes the collector of Q214 to decrease to a ground potential. This results in a negative-going voltage being applied to the base of transistor Q212 and establishes a forward bias for the base-emitter junction. Transistor Q212 turns on and its collector voltage rises to the emitter voltage or A+ potential. The collector of Q212 is tied to the base of Q204 and the presence of an A+ potential produces a reverse bias condition for transistor Q204. Since Q204 cannot turn on and transistor Q205 is not activated even though the emitter of Q205 has been placed at ground potential by turning on Q214. When tones 3 and 4 cease, Q212 stays on for approximately one second. Now, when tones 1 and 2 appear, transistor Q204 can not turn on since its base is still held at A+ potential. Thus, the decoder is not activated.

c. Group-Call Operation

To alert a number of receivers simultaneously, the associated base transmitter sends a group call code consisting of a single pulse of two simultaneous tones (tones 2 and 3). The tone modulated signal and the audio tones are recovered in the receiver discriminator. The signals are applied via J1-4 and the intercabling to P1-4, the input to the decoder board. Again, as in individual call operation, the input signals are coupled to emitter-follower stage Q200 which in turn feeds signals to Q201, the tone reed amplifier.

In the collector circuit of Q201, the input coils of the "Vibrasponder" tone reeds 2 and 3 will couple tones 2 and 3 to respective output coils. Tones 2 and 3 are now coupled to tone amplifiers Q202 and Q215 respectively. The output from transistor Q202 would normally (in individual call operation) turn on Q203. However, since tone 1 is not present, Q210 is not active, Q211 is not turned on and Q203 cannot be turned on since its emitter circuit is not completed. Instead, an output from the collector of Q202 (point "B" on the diagram) will apply tone to the base of Q217 in order to activate this transistor instead of Q203.

Meanwhile, tone 3 has been amplified by Q215 and the output of Q215 has caused Q216 to turn on and saturate. The collector circuit of transistor Q216 is completed to ground, placing a ground on the emitter and completing the circuit of Q217. With its emitter circuit complete and the tone 2 input on its base (point "B"), transistor Q217 turns on, (saturates) and its collector voltage decreases to near ground potential. With the collector of Q217 at ground, the base voltage of Q221 decreases toward ground potential as capacitor C230 begins to discharge through resistor R256, transistor Q217 (saturated) and transistor Q216 (saturated) to ground. Approximately 2.5 seconds after tones 2 and 3 begin, the voltage at the base of Q221 has decreased enough to allow Q221 to turn on.

Diode CR200 is used to bypass resistor R256 when the set is first turned on and applies A+ potential immediately to the base of Q221, preventing it from turning on and activating the decoder.

When Q221 turns on, its collector potential goes positive which applies a positive going voltage to transistor Q222. Transistor Q222 conducts and saturates, causing its collector potential to decrease to ground, causing the base of Q206 to move in a negative direction. Transistor Q206 will conduct, applying a positive pulse to its collector. This positive pulse causes transistors Q207, Q208 and Q209 to conduct, and keep the red A (alert) light on and the radio in the noise squelch

(receiving all on-frequency messages) condition. This same positive pulse also triggers the automatically timed-out tone oscillator which provides the alerting tone of approximately 3 seconds duration. These conditions will remain until the RESET switch is manually operated.

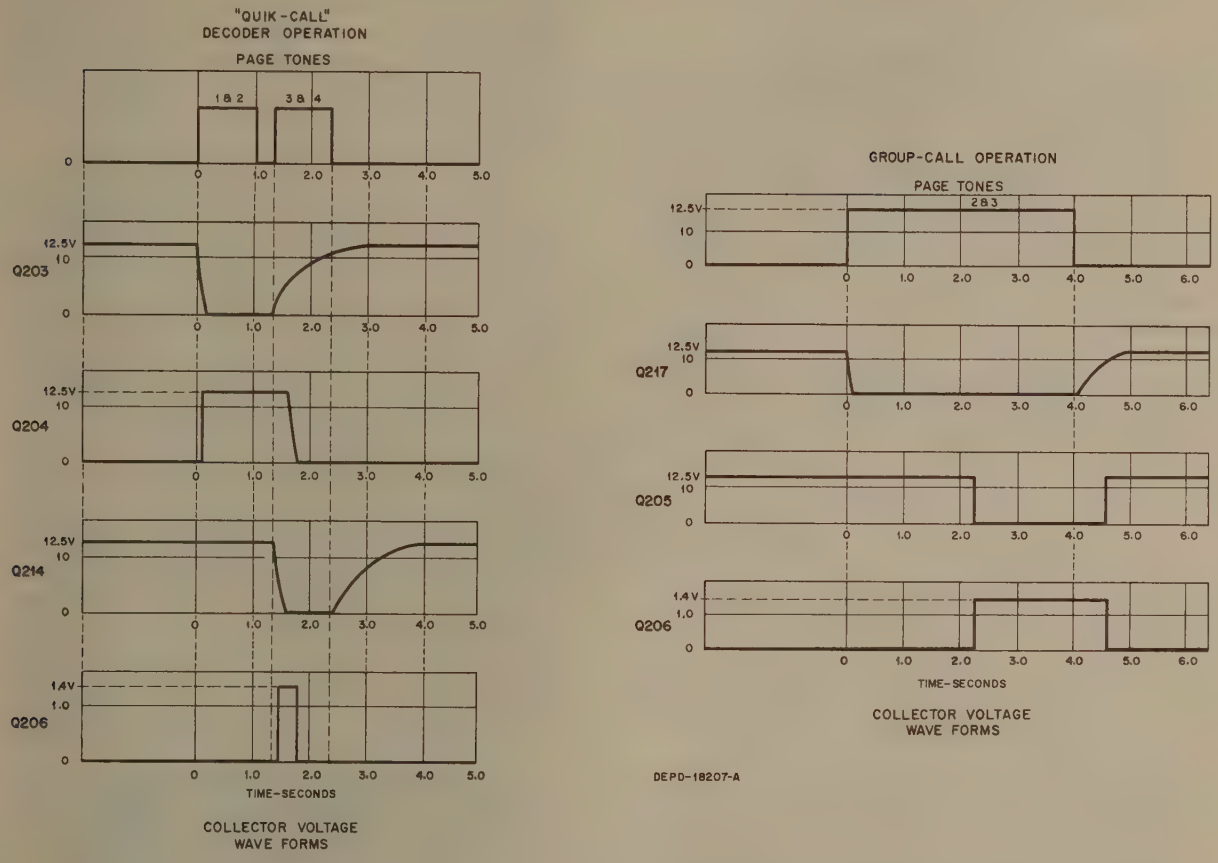


Figure 4.
"Quik-Call" Decoder Operation Waveforms

"VIBRASPONDER" REED FREQUENCIES AND DESIGNATIONS

CODE LETTER	FREQUENCY (CYCLES)	CODE LETTER	FREQUENCY (CYCLES)	CODE LETTER	FREQUENCY (CYCLES)
CZ	346.7	CB	371.5	CA	358.9
DZ	384.6	DB	412.1	DA	398.1
EZ	426.6	EB	457.1	EA	441.6
FZ	473.2	FB	507.0	FA	489.8
GZ	524.8	GB	562.3	GA	543.3
HZ	582.1	HB	623.7	HA	602.6
JZ	645.7	JB	691.8	JA	668.3
KZ	716.1	KB	767.4	KA	741.3
LZ	794.3	LB	851.1	LA	822.2
MZ	881.0	MB	944.1	MA	912.0
NZ	977.2	NB	1047.1	NA	1011.6
PZ	1084.0	PB	1161.4	PA	1122.1

6. "PRIVATE-LINE" TONE DECODER UNITS

a. General

The receiver discriminator output from P1-4 contains both voice and "Private-Line" tone. This output is applied to the input of an emitter-follower stage Q401. Output from the emitter-follower is fed through an active low-pass filter, which passes the "Private-Line" tone, but does not allow a significant amount of voice energy to reach the limiter stage. This is necessary to prevent the voice energy from capturing the limiter stage, which would cause the decoder to block. The "Private-Line" tone continues through an amplifier Q403 which drives the limiter stage Q404. The limiter has a low-value, unbypassed emitter resistor, to provide high input impedance for the stage and a stage gain approximately equal to the ratio of the value of collector resistor to the value of the emitter resistor.

The output from the limiter Q404 is coupled to the "Vibrasponder" resonant reed by the capacitor C. The high impedance (4.7K ohms) in series with the reed provides maximum drive to the reed, which is 6 db above its mechanical limiting level (twice the mechanical limiting voltage). The limiter begins to clip at 60% of the minimum "Private-Line" system deviation.

The output of the "Vibrasponder" resonant reed is applied to a single forced-gain amplifier stage Q405 whose operating point is stabilized by the compensating characteristics of diode CR401. Output from this amplifier stage is applied to the base of Q406, an emitter-biased detector stage for sensing presence of reed output. A dc bias voltage is applied to the emitter of Q106. When the signal on the base of Q406 exceeds this bias voltage, the transistor conducts, providing pulsed output. The collector load resistor has a high value for maximum gain. The base bias network contains a forward-conducting silicon diode to compensate for the drop across the transistor base-emitter junction. With this device, the threshold level is held constant with variations in temperature and voltage. The output from the detector is passed to an emitter-follower stage, Q407 with a capacitive load. This load achieves an impedance match and filtering of the pulses from the detector.

The setting of resistor R424 determines the dc voltage applied to the emitters of Q406 and Q408. This setting determines the decoder sensitivity (threshold of operation). The voltage difference between the emitters of Q406 and Q408 is held to be as small as possible, without impeding circuit operation, to eliminate a long "squelch tail" which would otherwise result from the discharge time related to C419 and R430 plus R432. The magnitude of the dc voltage on the emitter of the detector Q406 determines the magnitude of the signal necessary to turn Q406 on.

Transistors Q408, Q409 and Q410 comprise a monostable multivibrator circuit. When the correctly-coded tone is detected, Q407 will turn on and apply a positive voltage to the base of Q408. Q408, Q409 and Q410 will turn on and remove bias from terminal P1-3. With the bias removed from this terminal, the audio stages in the receiver become forward biased and audio will be heard at the speaker.

Since a low-pass filter restricts the bandwidth of noise, which can drive the "Vibrasponder" resonant reed when no signal is received, the decoder may be susceptible to false response to noise pulses (noise falsing). To minimize noise falsing, some high-frequency noise is shunted around the high-pass filter to reduce the amount of noise from the limiter at the "Vibrasponder" reed frequency. When a correctly-coded signal is received, diode CR403 is forward-biased, and the high-frequency components are removed.

A high-pass filter is inserted between the discriminator and the audio preamplifier (at P1-7 to P1-6) to attenuate the "Private-Line" tone frequencies reaching the audio output.

When the "Private-Line" circuit is in operation, A+ voltage is applied to the base of Q18, the receiver squelch switch, to disable the noise squelch circuitry.

b. Tamper-Proof "Private-Line" Decoders

The circuitry enclosed by an outline on the schematic diagram is included in tamper-proof decoders only. Noise squelch circuitry is not used in these models. Transistor Q410 and capacitor C422 make up a capacitor multiplier. This multiplier requires the voltage at the emitter of Q407 to be positive from 600 to 900 milliseconds before transistor Q412 can turn on, to turn on the alert light. With this circuit arrangement, a short noise burst, typically of 100-150 milliseconds duration, will not activate the alert light. The negative slope of C419 discharge is sensed by C423, which turns on Q411, and discharges C422. This action prevents a charge from accumulating across

C422 from successive noise bursts, with subsequent triggering of the alert light.

Once the base voltage of Q412 is raised to a sufficient level, the bistable multivibrator comprising Q412 and Q413 turns on and remains locked up. This turns on the alert light DS401 to indicate that a message has been received.

"PRIVATE-LINE" REED FREQUENCIES AND DESIGNATIONS

CODE NUMBER	FREQUENCY (CPS)	CODE NUMBER	FREQUENCY (CPS)	CODE NUMBER	FREQUENCY (CPS)
YZ	82.5	2Z	110.9	4B	146.2
YA	85.4	2A	114.8	5Z	151.4
YB	88.5	2B	118.8	5A	156.7
ZZ	91.5	3Z	123.0	5B	162.2
ZA	94.8	3A	127.3	6Z	167.9
ZB	98.1	3B	131.8	6A	173.8
1Z	100.0	4Z	136.5	6B	179.9
1A	103.5	4A	141.3	7Z	186.2
1B	107.2			7A	192.8

MAINTENANCE

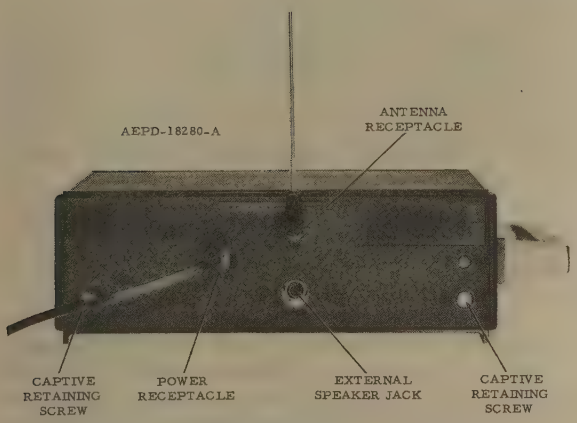


Figure 5.
Rear View of Receiver

1. DISASSEMBLY PROCEDURES

a. Removal of Receiver From Housing

To remove the receiver from the housing, disconnect the power cord from the receptacle on the rear of the receiver. Remove the antenna connector from the chassis receptacle. Disengage the two captive retaining screws in the back panel of the cabinet by turning counterclockwise until they are free of the radio chassis. Slide the chassis forward and out of the housing.

b. Removal of Tone Decoder Board

To remove the tone decoder board from the chassis of a selective signalling model, remove the four retaining screws located in each corner of the board. Lift board up and slightly rearward until front-panel switches and switch bracket clear the lip of the front panel. For alignment purposes, leave the interconnecting cable wires plugged to the main circuit board pins.

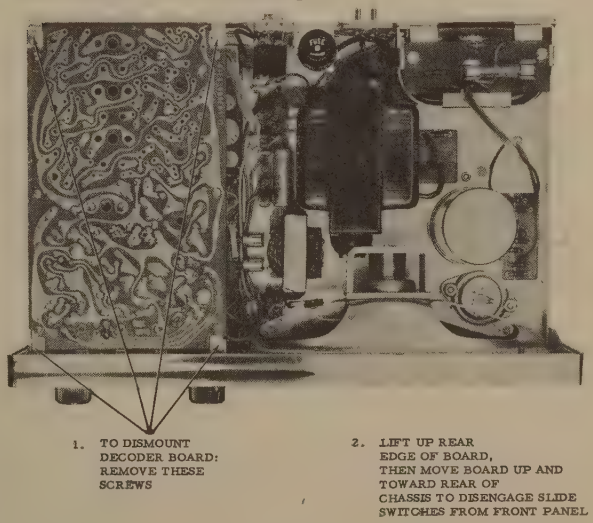

1. TO DISMOUNT DECODER BOARD: REMOVE THESE SCREWS
2. LIFT UP REAR EDGE OF BOARD, THEN MOVE BOARD UP AND TOWARD REAR OF CHASSIS TO DISENGAGE SLIDE SWITCHES FROM FRONT PANEL

Figure 6.
Tone Decoder Mounting Details

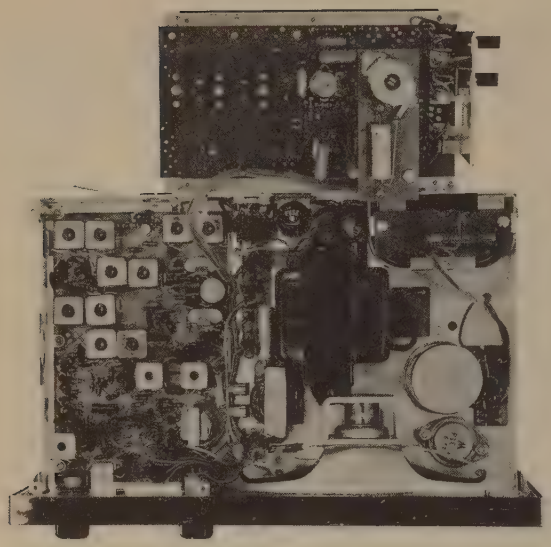


Figure 7.
Decoder Board Swung Out for Access to Main Board

If the interconnecting cable wires are disconnected for any purpose, they may be reconnected by matching the numbers on the wires to the corresponding pin numbers on the chassis.

2. PERFORMANCE CHECKS AND TROUBLESHOOTING

a. Receiver

(1) RF and IF Stages

A 20 db quieting sensitivity check may be used to evaluate overall performance of these stages. If this check indicates that the receiver is not operating properly, stage gain and ac (rf) signal voltage measurements can be used to isolate the defective stage. When the stage is located, dc voltage and resistance measurements can be used to locate the defective component. After repair, the 20 db quieting check should again be performed to determine if realignment is required.

The 20 db quieting check is outlined in step-by-step form later in this section of the manual. Charts containing rf measurement information are also included. The schematic diagram contains stage measurements and dc voltage readings at pertinent points. Refer to the measurement charts for input information and normal signal levels.

(2) Audio Stages

A step-by-step procedure in chart form is included in this section of the manual for use in determining whether the receiver is delivering the full rated audio output.

If this check indicates improper operation, ac signal measurements can be used to isolate the defective stage and dc voltage and resistance measurement can be used to determine the defective component.

A chart containing normal ac signal measurements is also included. These readings are shown on the schematic diagram also but the chart should be referred to for signal input information and measurement techniques. Refer to the schematic diagram for dc voltage readings.

b. Decoders

A procedure for checking decoder operation using an oscilloscope is also included in chart form. Proper waveforms are shown on the schematic diagram and the corresponding physical observation points are shown on the respective printed circuit board detail. If improper waveforms or improper decoder operation are encountered, refer to the Theory of Operation Section for details of operation and the respective schematic diagram for dc voltage measurements.

OVERALL RF & IF PERFORMANCE CHECK
(20 db Quieting Sensitivity)

Test Equipment Required:

(1) Motorola T1034C Signal Generator or equivalent.
(2) Motorola SKN6015A RF Adapter Cable
(3) Motorola S1056A-9A Portable Test Set or ac voltmeter

STEP	PROCEDURE
1	Connect signal generator to antenna receptacle (use adapter cable). Connect test set to metering receptacle or connect ac voltmeter across speaker voice coil.
2	Turn radio set on and turn squelch control fully counterclockwise (maximum noise). If test set is used, place SPKR switch in OPEN position and position selector switch in position II AUDIO.
3	With no output from signal generator, adjust volume control on receiver for reading of 1.4 v ac on test set (0-2) or ac voltmeter.
4	Hold test set multiplier switch in 0.2 v ac position and increase signal generator output (carrier frequency without modulation) until test set (or ac voltmeter) reads 0.14 volt. NOTE If ac voltmeter is used, volume control may be adjusted for any convenient reading in Step 3 and signal generator output adjusted for 1/10 of that reading in this step.
5	Read microvolt input on signal generator attenuator. This reading (20 db quieting sensitivity) should be less than 0.5 microvolt.

EPD-21031-O

AUDIO PERFORMANCE CHECK
(Full Rated Audio Output)

Test Equipment Required:

(1) Motorola T1034C FM Signal Generator, or equivalent.
(2) Motorola SKN6015A RF Adapter Cable
(3) Motorola Solid-State AC Voltmeter, or equivalent.

STEP	PROCEDURE
1	Apply a 1000-microvolt carrier frequency signal to external antenna receptacle.
2	Set modulation selector switch (MOD) to 1000 (cps). Adjust deviation control (DEV) for 3.3 kc on meter.
3	Set volume control on receiver to maximum and squelch control to minimum.* Measure ac voltage across speaker voice coil or from "hot" side of external speaker jack to ground. The ac voltmeter should indicate 2.53 volts for fully rated audio output.

*Procedure produces 2-watt audio output (high sound level). Speaker may be disconnected and resistor of similar value (approximately 3.2 ohms) connected in its place. If receiver is equipped with a decoder, place MON-ALERT switch in MON position.

EPD-21034-O

RF & IF CHECK USING TEST SET

TEST EQUIPMENT REQUIRED:

a. Motorola S1056A-9A Portable Test Set.

b. Motorola T1034C FM Signal Generator with TEK-10 RF Adapter Cable, or equivalent.

INPUT (Carrier Freq.) LEVEL	INPUT (Carrier Freq.) APPLIED AT	NORMAL INDICATION (SELECTOR SWITCH POSITION 1)
-21 dbm	Q2 Collector	0*
-66 dbm	Q2 Base	
-72 dbm	Q1 Collector	
-87 dbm	Q2 Base	
-92 dbm	Antenna Receptacle	

*With no input, meter will indicate negative reading. As input is increased, reading will go to zero and then to positive indication.

EPD-21190-O

AUDIO AMPLIFIER MEASUREMENTS

Test Equipment Required:

(1) Motorola TEK-1A Tone Generator (1000 cps) or equivalent.
(2) Motorola Solid-State AC Voltmeter or equivalent.

1000 CPS INPUT APPLIED AT	1000 CPS INPUT LEVEL	OUTPUT MEASURED AT	OUTPUT AC READING	REMARKS
J1-6 on Receiver Board	4.2 Millivolts	Speaker	.34 v (-7 dbm)	Remove jumper between J1-6 and J1-7 on receiver board while making measurements.
		Q12 Collector	.42 v (-5 dbm)	
		Q12 Base	3.4 mv (-47 dbm)	
		Q11 Emitter	3.9 mv (-46 dbm)	
		Q11 Base	4.0 mv (-45.5 dbm)	
	35 Millivolts	Speaker	2.53 v	
		Q13 Collector	8.0 v	
		Q13 Base	0.75 v	
		Q12 Collector	2.0 v	

EPD-21035-O

RF & IF MEASUREMENTS

TEST EQUIPMENT REQUIRED:

a. Motorola Solid-State DC Multimeter with RF Probe, or equivalent.

b. Motorola T1034C FM Signal Generator, or equivalent.

c. Motorola SKN6015A RF Adapter Cable.

No Signal Input (Noise Only)

MEASURED AT	NORMAL INDICATION	SPECIAL INSTRUCTIONS
Q10 Collector	+4 dbm (1.2 v rf)	
Q10 Base	-4 dbm (0.5 v rf)	
Q8 Base	-35 dbm (0.014 v rf)	
	-55 dbm (0.001 v rf)	measurement made with .02 uf collector to ground
	-55 dbm (0.001 v rf)	measurement made with .02 uf connected from Q2 collector to ground
Q7 Base	-55 dbm (0.001 v rf)	
	-65 dbm (0.00045 v rf)	measurement made with 100 uuf connected from Q1 collector to ground

Carrier Signal Input (Signal Generator at Antenna Receptacle)

MEASURED AT	NORMAL INDICATION	INPUT LEVEL
Q10 Collector	+3 dbm (1.1 v rf)	3 microvolts
Q10 Base	-4 dbm (0.48 v rf)	
Q7 Base	-20 dbm (0.078 v rf)	
455 KC Filter Output	-35 dbm (0.014 v rf)	
Q3 Collector	-40 dbm (0.0078 v rf)	
Q8 Collector	1.0 v rf	-113 dbm
Q7 Collector	1.0 v rf	-88 dbm
	0.3 v rf	-109 dbm
Q4 Collector	0.3 v rf	-89 dbm
Q4 Base	0.3 v rf	-63 dbm
Q3 Collector	0.3 v rf	-83 dbm
Q3 Base	0.3 v rf	-38 dbm
Q2 Collector	0.3 v rf	-53 dbm

EPD-21189-O

DECODER TROUBLESHOOTING PROCEDURE

Test Equipment Required:

(1) Motorola T1034C FM Signal Generator, or equivalent.
(2) Motorola SKN6015A RF Adpater Cable.
(3) Motorola TEK-34A Universal Tone Generator, or equivalent.
(4) Motorola T1015A Osilloscope, or equivalent.
(5) Motorola Solid-State DC Multimeter, or equivalent.

STEP	PROCEDURE
1	Inject a 1000-microvolt carrier frequency signal at external antenna receptacle.
2	Set modulation selector switch (MOD) on signal generator for external (EXT) modulation. Connect tone generator to external modulation terminals of signal generator and with correct tone(s) applied, adjust to rated deviation.
3	Refer to applicable schematic diagram for waveform information and printed circuit detail for observation points and compare waveforms.
4	If waveforms observed are incorrect, refer to schematic diagram and use dc voltage and resistance measurements to locate defective component.

EPD-21036-O

3. ALIGNMENT PROCEDURES

a. Basic Receiver

For details of alignment and metering points, refer to Receiver Alignment Procedure EPD-18919. Test equipment required and oscillator crystal frequencies are also included.

b. Model NLN1046A Single-Tone Decoder Unit

(1) Test Equipment Required

Motorola Transistorized AC Voltmeter
Motorola DC Multimeter
Motorola FM Signal Generator
Motorola S1067A Audio Oscillator
Motorola T1014B Wideband Oscilloscope
Motorola S1075B Digital Frequency Counter

(2) Alignment Procedure

(a) Connect the receiver to 117 volts ac, using the line cord supplied with the receiver.

(b) Connect the signal generator to the receiver antenna input using the SKN6014A RF Adapter Cable.

(c) Set the signal generator to the assigned receiver frequency by monitoring the discriminator output (J5-4) with a dc voltmeter for a zero reading. Adjust the rf level to 1 millivolt.

(d) Set the audio oscillator to the assigned decoder frequency with the frequency counter.

(e) Modulate the signal generator at 3.3 kc deviation with the output of the audio oscillator.

(f) Connect the ac voltmeter to metering point M101 (tan) on the decoder board and adjust the pot core tuning slug for maximum voltage not to exceed +6 dbm. If the reading exceeds this value, reduce it by adjusting resistor R109.

(g) With the decoder in final position firmly mounted on the receiver, adjust R109 for a +4.6 dbm reading at the metering point.

(h) With the audio oscillator set to the decoder frequency, check the paging sensitivity of the unit by reducing the rf level into the unit until the unit will no longer respond. The lowest value of rf input at which the decoder will still respond to the tone is its alerting sensitivity. The alerting sensitivity should be not more than 0.18 microvolt.

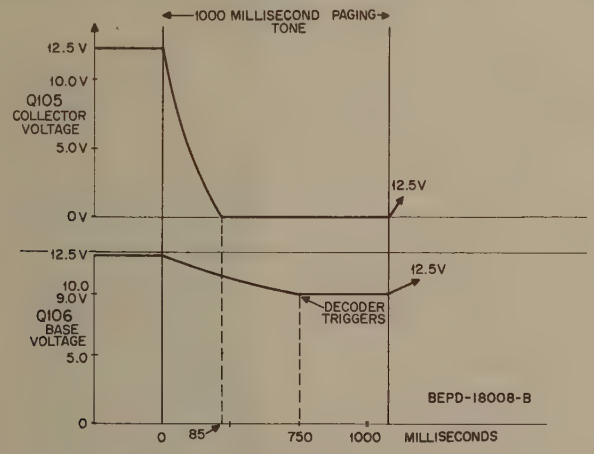


Figure 7.
Typical Operation During 1000 Millisecond Paging Tone

NOTE

The transmitter single-tone encoder must produce 3.3 kc deviation for proper operation of the receiver single-tone decoder. Transmitter deviation less than 3.3 kc will result in degradation of decoder bandwidth. Deviation greater than 3.3 kc will reduce the available amount of protection against voice and noise falsing operation.

c. Model NLN6577A "Quik-Call" Decoder Unit
Model NLN6578A Two-Tone Sequential Decoder Unit

These decoder units require no special alignment procedures. For voltage readings, refer to the appropriate schematic diagram. For waveform details, refer to the Theory of Operation.

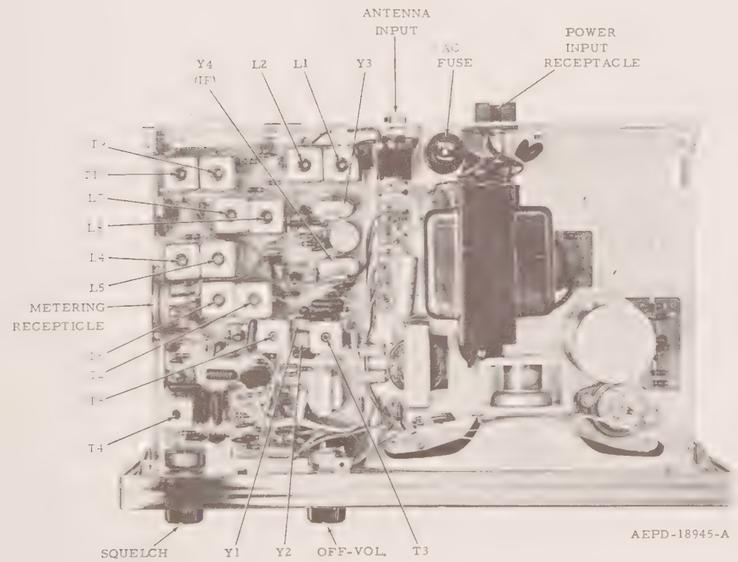
TEST EQUIPMENT REQUIRED FOR ALIGNMENT

1. Motorola FM Signal Generator or equivalent.
2. Motorola Model S1056A-9A Series Test Set with 455 kc crystal or equivalent crystal oscillator.
3. Motorola Model NKN6131A Antenna Adapter Cable.
4. Motorola Model NLN6598A Alignment Tool (supplied).
5. Motorola Model S1078A Digital Frequency Meter and Deviation Monitor.

PRELIMINARY SET-UP FOR ALIGNMENT

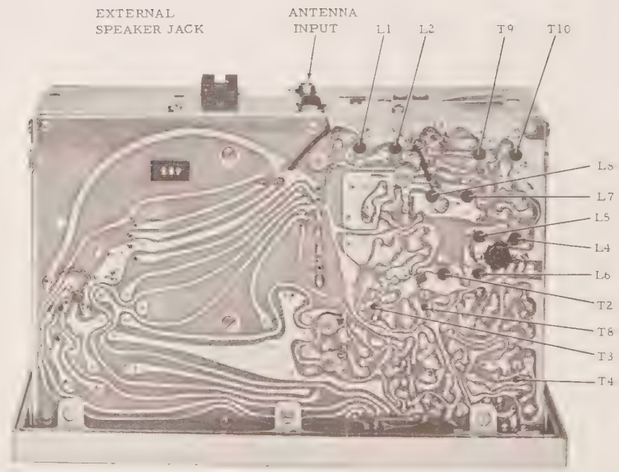
1. Remove receiver from housing by loosening the two captive screws on the rear of the radio case, then withdrawing the chassis.
2. Set all coil slugs flush with top of coil forms, as viewed from component side of circuit board, except L4, L5, L6, T2, T3, T4 and T8.
3. Connect radio to 117 volt ac or to +13.8 volt dc supply. Turn on receiver, and set SQUELCH control for maximum noise (control fully counterclockwise).
4. If radio is equipped with tone decoder, set MON-ALERT switch to MON position.
5. Connect signal generator to antenna receptacle.

FREQUENCY OF OPERATION	SECOND OSCILLATOR CRYSTAL FREQUENCY AND TYPE	RECEIVER MODEL NO.
30.000-30.860	5.245 G20	NRB6152AB
30.861-36.840	6.155 G19	NRB6152AB
36.841-37.000	5.245 G20	NRB6152AB
37.001-42.000	6.155 G19	NRB6152AB
42.000-42.999	6.155 G19	NRB6153AB
43.000-43.160	5.245 G20	NRB6153AB
43.161-49.140	6.155 G19	NRB6153AB
49.141-49.320	5.245 G20	NRB6153AB
49.321-54.000	6.155 G19	NRB6153AB



AEPD-18945-A

OL-DEPD-18944-O



AEPD-18946-A

ALIGNMENT PROCEDURE

STEP	TEST EQUIPMENT	TEST SET METER POSITION	ADJUSTMENT	PROCEDURE
1	Test Set	4	T4 Limiter/ Discriminator	Connect the test set metering plug to the metering receptacle on the receiver. With the receiver turned off, note the position of the meter needle on the test set. Turn the receiver on and inject a 455 kc signal with the test set probe to the base of Q4. Adjust T4 to produce the same position of the meter needle as noted previously, with the tuning slug near the top of the coil.
2	FM Signal Generator & Test Set	1	L4, L5, L6, T2	Place test set in METER REVERSE position. (If signal cannot be driven through the receiver, inject a 5.7 mc signal at the base of Q2.) Adjust for maximum dip. If meter needle passes the zero mark, reduce signal input level.
3	FM Signal Generator Test Set	4	Signal Generator	Connect signal generator to antenna input receptacle using SKN6015A RF Adapter Cable. Increase r-f input from signal generator until receiver quiets, then adjust signal frequency for center scale zero on test set meter. Do not set generator frequency to 2nd i-f image frequency.*
4	FM Signal Generator Test Set	1	T3, T8, L1, T9 L2, T10, L8, L7 L4, L5, L6, T2	Switch test set to METER REVERSE position. Tune each slug in succession for maximum dip on meter. When meter passes through zero, reduce level of input signal.
5	Base Station Transmitter Digital Frequency Meter/Deviation Monitor Test Set	4	C19	With the base station transmitter or the Digital Frequency Meter as a signal source at the carrier frequency, adjust C19 for a center scale zero reading on test set meter.
6	FM Signal Generator Test Set	11	Signal Generator Output	Set SPKR control on the test set to OPEN. Turn the receiver squelch control fully counterclockwise. With no input signal, adjust the VOL control for a reading of 1.4 volts on the 2 volt meter scale. With the test set meter range switch moved and held to the 0.2 V AC position, increase the r-f output from the signal generator until the test set meter reads 0.14 volt on the 0.2 V AC range. Read the signal generator attenuator in microvolts. Reading should be less than 0.35 microvolt. This reading is the 20 db quieting level of the radio.

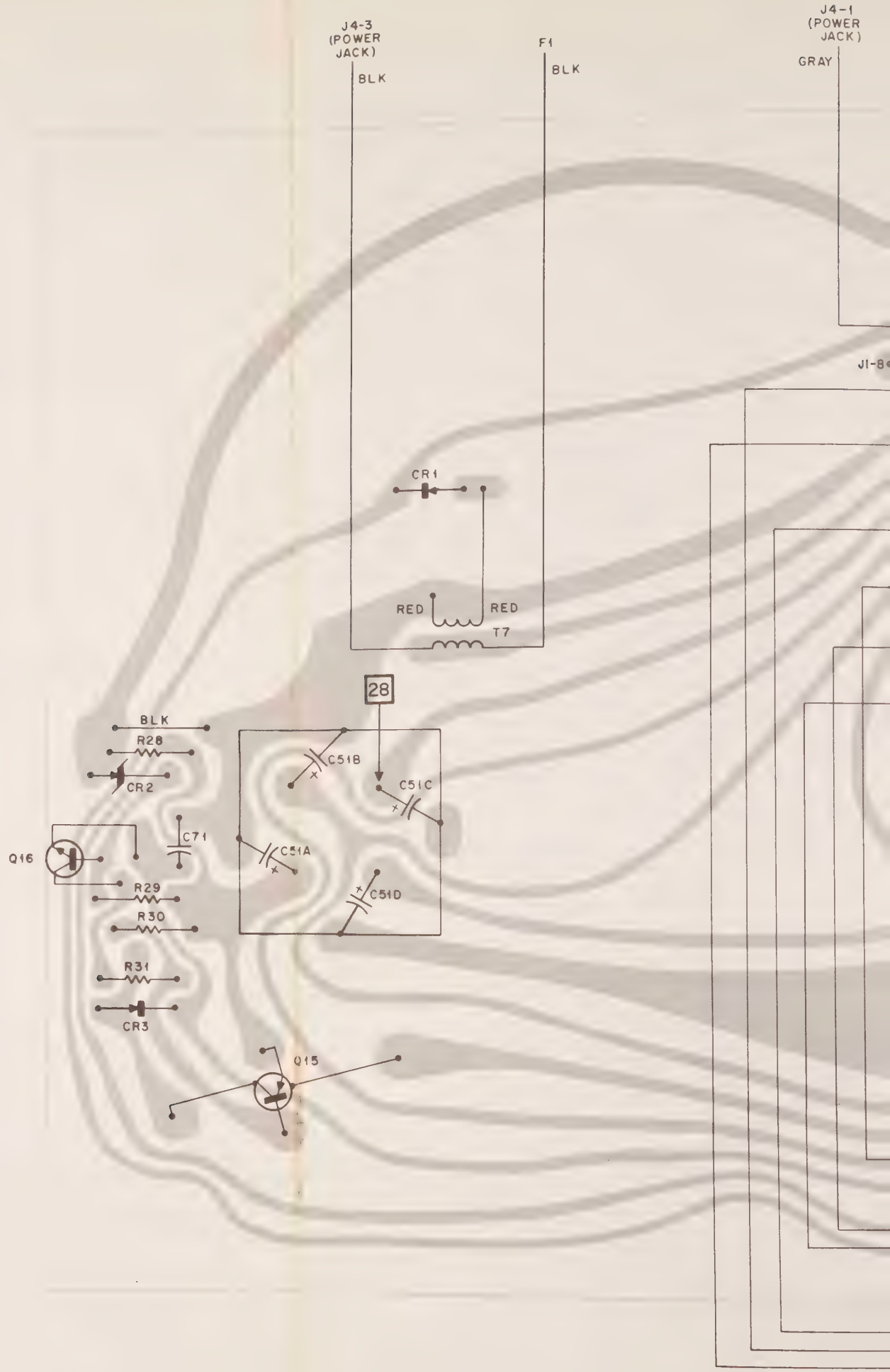
*Do not set generator to 2nd IF image frequency. See explanation below:

For 30-42 mc:
Image = 910 kc below F_c when Y4 crystal frequency is 6.155 mc
Image = 910 kc above F_c when Y4 crystal frequency is 5.245 mc

For 42-54 mc:
Image = 910 kc below F_c when Y4 crystal frequency is 5.245 mc
Image = 910 kc above F_c when Y4 crystal frequency is 6.155 mc

REVISIONS

DIAG ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	NRB6152AB-1 NRB6153AB-1	C58	WAS .05 uf	BOTTOM RIGHT OF BD
		61	REMOVED .05 uf	BOTTOM CENTER OF BD
		C71	ADDED .0033 uf	LEFT MIDDLE OF BD
		C72, 73	WERE 100 uuf	BOTTOM CENTER OF BD
		Q11	WERE TYPE M9532	BOTTOM RIGHT OF BD
		[illegible]		MIDDLE LEFT OF BD
		[illegible]		BOTTOM RIGHT OF BD
		Q19		
		R56	WAS 1.5K	BOTTOM CENTER OF BD
[illegible]	NRB6152AB-2 NRB6153AB-2	R64	ADDED 4.7K	T5 PRIMARY
C	NRB6152AB-4 NRB6153AB-4		ADDED GROUND LEAD	BOTTOM CENTER OF BOARD
D	NRB6152AB-5 NRB6153AB-5	XDS1	WAS 9B83567E01	PARTS LIST
E	NRB6152AB-6 NRB6153AB-6	R64	WAS 6S185B87, 4.7K; 1/8 W	PARTS LIST
F	NRB6152AB-7 NRB6153AB-7	R57	WAS 6S131594, 27	PARTS LIST
	NRB6162AB-1 NRB6163AB-1		ADDED	

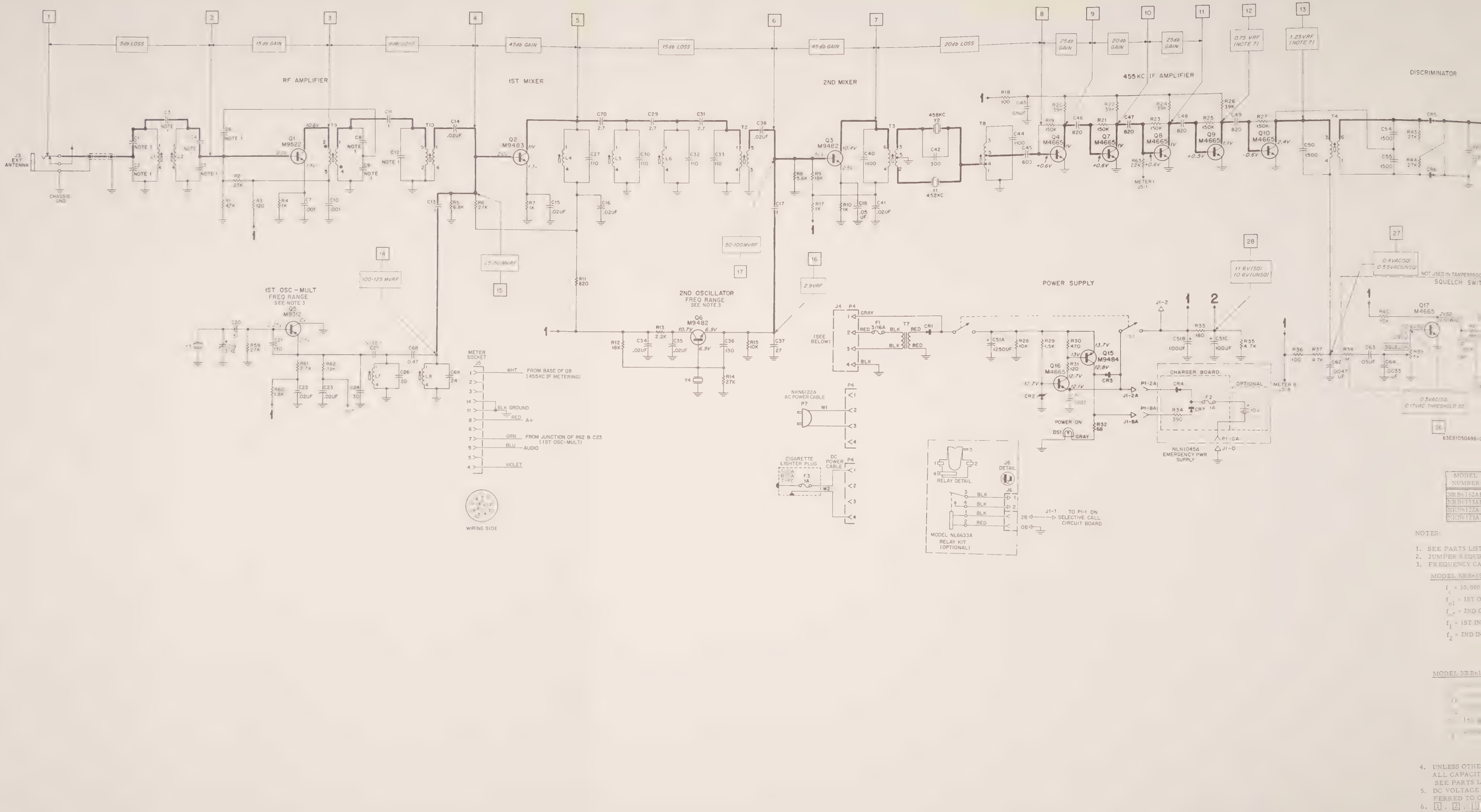


NRB6152AB-6, NRB6153A-6
Receiver Printed Circuit
Board Detail
Motorola No. PEPD-18885-F
2/16/68-AP

J4-4 POWER JACK)
BLK
J2 (EXT. SPKR)
WHT
VIOLET
J3 (ANT. JACK)
TO CHASSIS GND
G
J1-0
J1-1
J1-2
J1-3
J1-4
J1-5
J1-6
J1-7
C60
C1
C2
L1
C3
L2
C5
C4
R1
C7
R4
Q1
C6
C8
R2
R3
C9
T9
C10
C11
C12
T10
C14
Q2
R5
R7
C15
R6
Y3
Q5
C25
C24
C20
L7
C68
C69
L8
C13
R11
C23
R59
C21
R62
R61
C22
R60
C19
C26
C37
R15
C36
C17
C35
Y4
Q6
R14
C34
R12
R13
R9
C40
C41
R17
Q3
R8
C38
C18
R10
T2
C33
C31
C32
L6
R59
C70
C29
L5
C30
L4
C27
C16
J5
BLU
9
RED
8
WHT
1
GRN
7
14
BLK
11
VIOLET
4
(METERING JACK)
C43
R24
Q8
C47
R23
C48
Q9
R26
R22
R25
C49
12
11
10
9
8
7
6
5
4
3
2
1
J5 DETAIL
C45
R19
R21
Q7
R20
Q4
C46
R27
Q10
C62
C65*
R41
*R40
R36
R18
R33
R53
R54
R52
*C67
*Q17
R43
R37
C50
13
T4
C55
C54
CR5
R44
CR6
*C64
*R38
C63*
27
26
*R39
T3
Y1
Y2
T8
C44
R58
R57
CR7
C72
T5
Q12
*Q18
R51
*R42
C66*
Q11
R64
R56
C73
R55
Q19
R50
C59
R45
C56
R35
C58
R46
C57
R47
R49
R48
R32
S1
24
25
22
20
18
21
19
23
17
16
15
14
10
9
8
7
6
5
4
3
2
1
T6
Q13
Q14
R57
R58
CR7
C72
T5
Q12
*Q18
R64
R56
C73
R55
Q19
R32
S1
R48
R49
R47
R46
C57
C58
R35
C59
R50
C66*
Q11
R51
*R42
*C67
*Q17
R52
R54
R53
R33
R36
*R40
R18
R20
Q4
C44
T8
Y1
Y2
T3
C42
C45
R19
R21
Q7
C46
C65*
*R41
R27
Q10
C62
R43
R37
C50
T4
C55
C54
CR5
R44
CR6
*C64
*R38
C63*
*R39
R59
C31
C32
T2
C33
L6
C43
R24
Q8
C47
R23
C48
Q9
R26
R22
R25
C49
C36
C17
C35
Y4
Q6
R14
C34
R12
R13
R9
C40
C41
R17
Q3
R8
C38
C18
R10
C37
R15
C70
C29
L5
C30
L4
C27
C16
C60
C1
C2
L1
C3
L2
C5
C4
R1
C7
R4
Q1
C6
C8
R2
R3
C9
T9
C10
C11
C12
T10
C14
Q2
R5
R7
C15
R6
Y3
Q5
C25
C24
C20
L7
C68
C69
L8
C13
R11
C23
R59
C21
R62
R61
C22
R60
C19
C26
J1-0
J1-1
J1-2
J1-3
J1-4
J1-5
J1-6
J1-7
G
BLK
WHT
VIOLET
J2 (EXT. SPKR)
J3 (ANT. JACK)
TO CHASSIS GND
J4-4 POWER JACK)
J5
BLU
RED
WHT
GRN
BLK
VIOLET
(METERING JACK)
J5 DETAIL
DS1 (LIGHT, POWER)
LS1

* NOT USED IN TAMPERPROOF "PRIVATE-LINE" MODELS.

OL-DEPD-18884-D



MODEL NUMBER
NRB6152A
NRB6153A
NKN6122A
NKN6123A

NOTES:

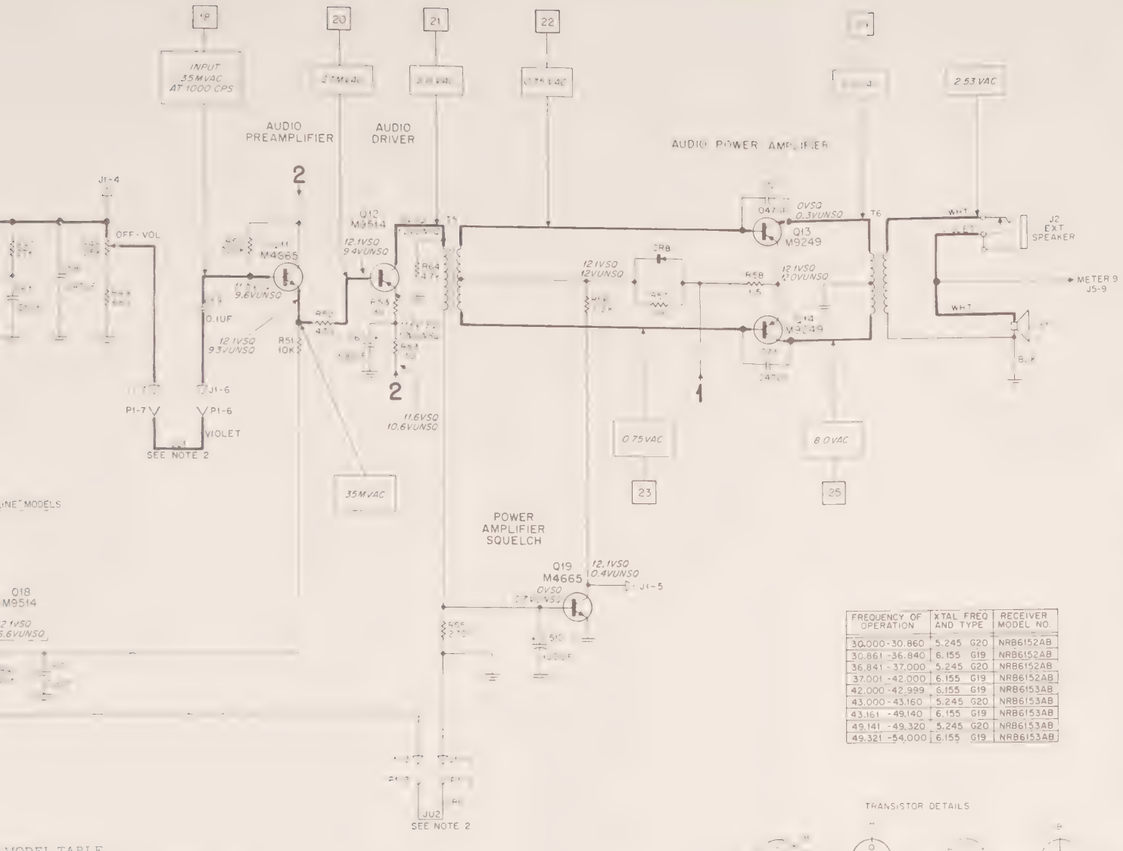
1. SEE PARTS LIST
2. JUMPER REQUI
3. FREQUENCY CA

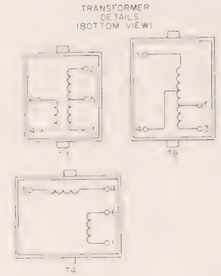
MODEL NRB6

f_c = 30.000
f_{o1} = 1ST O
f_{o2} = 2ND O
f_1 = 1ST IN
f_2 = 2ND IN

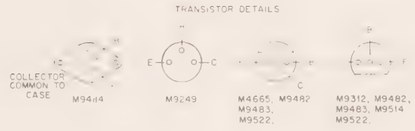
MODEL NRB6

4. UNLESS OTHE ALL CAPACIT SEE PARTS L
5. DC VOLTAGE FERRED TO G
6. 1, 2, 11 BOARD DETA





FREQUENCY OF OPERATION	XTAL FREQ AND TYPE	RECEIVER MODEL NO.
30.000-30.860	5.245 G20	NRB6152AB
30.861-36.840	6.155 G19	NRB6152AB
36.841-37.000	5.245 G20	NRB6152AB
37.001-42.000	6.155 G19	NRB6152AB
42.000-42.999	6.155 G19	NRB6153AB
43.000-43.160	5.245 G20	NRB6153AB
43.161-49.140	6.155 G19	NRB6153AB
49.141-49.320	5.245 G20	NRB6153AB
49.321-54.000	6.155 G19	NRB6153AB



NET MODELS

MODEL TABLE

	DESCRIPTION
	RECEIVER CHASSIS (30-42 MC)
	RECEIVER CHASSIS (42-54 MC)
	AC POWER CABLE KIT
	DC POWER CABLE KIT

FF.
OISE-SQUELCH MODELS.
NS:

CARRIER FREQUENCY
CRYSTAL FREQUENCY = 11.9-15.9 MC
R CRYSTAL FREQUENCY - REFER TO CHART
TE FREQUENCY = 5.7 MC
TE FREQUENCY = 455 KC

$\frac{f_c + 5.7\ mc}{3}$

CARRIER FREQUENCY
CRYSTAL FREQUENCY = 12.1-16.1 MC
R CRYSTAL FREQUENCY - REFER TO CHART
TE FREQUENCY = 5.7 MC
TE FREQUENCY = 455 KC

$\frac{c}{3}$

FIED:
ARE IN MICROMICROFARADS.
ISTOR WATTAGE RATING.
RE TAKEN WITH 13.8 V DC INPUT AND RE-
ND.
ER TO THE CORRESPONDING CIRCUIT BOARD
MENT POINTS.
T ONLY (NO SIGNAL).

EPD-18014-A

PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON BACK OF THIS DIAGRAM

30-54 MC Transistorized Alert Monitor
FM Receiver Schematic Diagram
Motorola No. 63E81050A96- G1
2/16/68-AP

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
A	NRB6152AB-1 NRB6153AB-1	C58	WAS 21C82372C04, .05 uf	DISCRIMINATOR	RCVR BD PEPD-18885-A
		C61	REMOVED 21C82372C04, .05 uf WAS CONNECTED BETWEEN JUNCTION OF T5 PRI WITH Q12 COLLECTOR AND JUNCTION OF T6 SEC WITH J2 EXT SPKR JACK (WHT)	AUDIO POWER AMPLIFIER	
		C71	ADDED .0033 uf	Q16 EMITTER (POWER SUPPLY)	
		C72	WERE 21D82133G03, 100 uuf	Q13	
		[illegible]		Q14	
		Q11	WERE 48R869532, TYPE M9532	AUDIO PRE-AMPL	
		Q16		POWER SUPPLY	
		Q17		SQUELCH SWITCH	
		Q19		POWER AMPL SQUELCH	
		R56	WAS 6S127803, 1.5K	T5 SEC CENTER TAP	
B	NRB6152AB-2 NRB6153AB-2	R64	ADDED 4.7K	T5 PRIMARY	RCVR BD PEPD-18885-B
C	NRB6152AB-3	R31	ADDED 120 OHMS	PARTS LIST	RCVR BD PEPD-18885-B
		R49	WAS 6S129224, 82 OHMS	DISCRIM. OUTPUT	
D	NRB6152AB-4 NRB6153AB-4		ADDED GROUND LEADS	J3	PEPD-18885-C
E	NRB6152AB-5 NRB6153AB-5	XDS1	WAS 9B83567E01	PARTS LIST	PEPD-18885-D
F	NRB6152AB-6 NRB6153AB-6	R64	WAS 6S185B87, 4.7K, 1/8 W	PARTS LIST	PEPD-18885-E
G	NRB6152AB-7 NRB6153AB-7 NRB6162AB-1 NRB6163AB-1	R57	WAS 6S131594, 27	Q13 EMITTER	NONE
G1			ADDED MODELS NRB6162AB, NRB6163AB	PARTS LIST & SCHEM. DIAG.	PEPD-18885-F

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

NRB6162AB Receiver Chassis (30-42 MC) No Squelch
NRB6163AB Receiver Chassis (42-54 MC) No Squelch
NRB6152AB Receiver Chassis (30-42 MC)
NRB6153AB Receiver Chassis (42-54 MC) EPD-18950-B

		CAPACITOR, fixed: uuf ±5%; 500 v; unl. stated
C1, 4, 8	21D82133G39	36; N150 (NRB6152AB NRB6162AB)
	or21D82133G67	20; N150 (NRB6153AB NRB6163AB)
C2	21D82610C28	130; 200 v; N470 (NRB6152AB NRB6162AB)
	or21D82610C68	80; 200 v; N150 (NRB6153AB NRB6163AB)
C3	21D82450B32	2.7 (NRB6152AB NRB6162AB)
	or21D82450B17	2.2 (NRB6153AB NRB6163AB)
C5	21D82610C68	80; 200 v; N150 (NRB6152AB NRB6162AB)
	or21D82133G68	40; N150 (NRB6153AB NRB6163AB)
C6	21D82450B13	1.5 (NRB6152AB NRB6162AB)
	or21D82450B17	2.2 (NRB6153AB NRB6163AB)
C7, 10	21D83596E01	.001 uf ±10%
C9	21D82610C28	130; 200 v; N470 (NRB6152AB NRB6162AB)
	or21D82610C44	100; 100 v; N220 (NRB6153AB NRB6163AB)
C11, 13, 17	21K864518	1.0 ±10%
C12	21D82133G75	30; N150 (NRB6152AB NRB6162AB)
	or21D82133G69	15; N150 (NRB6153AB NRB6163AB)
C14, 15, 16, 22, 23, 34, 35, 38, 41	21D82428B26	.02 uf +80-20%; 200 v
C18, 43, 57	21C82372C04	.05 +80-20%; 25 v
C19	20C82959G03	var; 3-12; 350 v; NP0
C20	21D82610C62	51; 100 v; N150
C21, 36	21D82610C28	130; 200 v; N470
C24	21D82133G75	30; N150
C25	21D82133G22	8 ±0.5 uuf; NP0 (NRB6152AB NRB6162AB)
	or21D82133G45	3 ±0.5 uuf; NP0 (NRB6153AB NRB6163AB)
C26	21D82133G67	20; N150
C27, 30, 32, 33	21D82610C69	110; N150
C29, 31, 70	21D82450B32	2.7
C37	21D82133G23	27 ±10%; NP0
C40, 44	21D83003G01	1100; 100 v
C42	21D83003G04	300; 100 v
C45	21D82428B34	.0006 uf ±10%
C46, 47, 48, 49	21D82187B21	820 ±10%; 200 v
C50, 54, 55	21D83003G03	1500 ±2%; 100 v
C51	23D83590E01	4 section c/o:
C51A		⌓ 1250 uf +150-10%; 35 v
C51B		□ 100 uf +150-10%; 35 v
C51C		△ 100 uf +150-10%; 35 v
C51[illegible]		100 uf +150-10%; 35 v
C56	21D83596E02	.002 uf ±10%; 200 v
C58, 72, 73	8C83514E03	.047 uf ±10%; 50 v
C59, 67	21C82372C01	0.1 uf +80-20%; 25 v
C60	23D82601A25	100 uf +150-10%; 20 v
C62	21D82428B56	.0047 uf ±10%; 200 v
C63	21C82372C04	.05 +80-20%; 25 v; NRB6152AB NRB6153AB
C64	21D82428B57	.0033 uf ±10%; 200 v; NRB6152AB, NRB6153AB
C65	23D83214C20	10 uf ±20%; 20 v; NRB6152AB, NRB6153AB
C66	21C82372C01	0.1 uf +80-20%; 25 v; NRB6152AB, NRB6153AB
C68	21D82450B37	0.47
C69	21D82133G74	24; N150
C71	21D82428B57	.0033 uf ±10%; 200 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR1, 3	48C82466H01	silicon
CR2	48D83461E02	silicon
CR5, 6	48C82139G01	germanium
CR8	48C83330G01	germanium

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

DS1	65C83573E01	LAMP, incandescent: .065 amp; 14 v
		FUSE:
F1	65K892098	3/16 amp; 125 v
		CONNECTOR, receptacle:
J2	9C83571E01	phone jack; single contact
J3	9C83586E01	phone jack; single contact
J4	28C83511G01	male; 4 contact
J5	9C83478E01	female; 12 contact
		COIL ASSEMBLY, RF:
L1, 2, 7, 8	24D83606E06	10-1/2 turns; incl. 76B83607E02 CORE, tuning
L4, 5, 6	24D83606E09	30-1/2 turns; incl. 76B83607E03 CORE, tuning
		SPEAKER:
LS1	50D83566E01	3.2 ohm; 2-1/4" x 6-1/4"; oval
		TRANSISTOR: (SEE NOTE I)
Q1	48K869522	N-P-N; type M9522
Q2	48R869483	N-P-N; type M9483
Q3, 6	48R869482	N-P-N; type M9482
Q4, 7, 8, 9, 10, 11, 16, 19	48R134665	N-P-N; type M54 ORG
Q5	48R869312	P-N-P; type M9312
Q12	48R869514	P-N-P; type M9514
Q13, 14	48R869249	P-N-P; type M9249
Q15	48R869484	P-N-P; type M9484
Q17	48R134665	N-P-N; type M54 ORG: NRB6152AB, NRB6153AB
Q18	48R869514	P-N-P; type M9514; NRB6152AB, NRB6163AB
		RESISTOR, fixed: ±10%; 1/4 w unl. stated
R1, 35, 37, 64	6S127804	4.7K
R2, 6, 14, 43, 44, 47, 59	6S127806	27K
R3, 31	6S129617	120
R4, 7, 10, 17, 46	6S127802	1K
R5	6S128687	6.8K
R6	6S129433	5.6K
R9, 12	6S128904	18K
R11	6S129432	820
R13, 56	6S128689	2.2K
R15, 28, 51	6S129225	10K
R18, 36, 57	6S129753	100
R19, 21, 23, 25, 27	6S129146	150K
R20, 22, 24, 26, 62	6S128903	39K
R29	6S127803	1.5K
R30, 52	6S127801	470
R32, 54	6S129861	68
R33	6S129662	180
R38	6S127802	1K; NRB6152AB, NRB6153AB
R39	18C83518E01	var; 5K; NRB6152AB, NRB6153AB only
R40	6S129225	10K; NRB6152AB, NRB6153AB
R41	6S128904	18K; NRB6152AB, NRB6153AB
R42, 63	6S128685	22K
R45	6S127805	15K
R48	18C83519E01	var; 25K
R49	6K128599	680
R50	6S129147	220K
R53	6S129755	10
R55	6S129752	270
R58	17C82350A07	1.5; 1 w
R60	6S129269	1.8
R61	6S128688	2.7K
		TRANSFORMER:
T2	24D83606E10	coded GRN: pri; pins 1 & 4 sec: pins 5 & 3
T3	24D83517E03	pri: pins 6 & 4, sec: pins 2 & 3; tapped at 5
T4	24D83542E01	pri: pins 4 & 3 sec: pins 1 & 6

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

T5	25C83539E01	audio driver: pri; res 50 ohms pins 1 & 2; sec; res 60 ohms; pins 3 & 5; tapped at 4
T6	25C83548E01	audio output; pri; res 4.38 ohms ±10%; pins 1 & 3; tapped at 2; sec; res 0.26 ohms ±10%; pins 4 & 5
T7	25C83242E01	power; pri; res 21 ohms ±10%; pins 1 & 2; sec res 0.87 ohms ±10%; pins 3 & 4
T8	24D83517E02	auto; input pins 4 & 1; output pins 5 & 1
T9	24D83606E07	coded VIO; pri; pins 1 & 4 sec: pins 5 & 2
T10	24D83606E08	coded YEL; pri pins 5 & 2; sec: pins 1 & 4
		SOCKET, lampholder:
XDS1	9B83567E02	midget type; spring loaded; screw base
		FUSEHOLDER:
XF1	9K865564	for 3AG fuse; female; retainer type
		RESONATOR, ceramic:
Y1	48D83192C11	452 kc
Y2	48D83192C12	458 kc
NON-REFERENCED ITEMS		
	26A82076C03	SHIELD, coil: 10 req'd
	42A83941E01	CLAMP, cable
	42K81973	CLIP, fuse; 2 req'd
	41B83007G01	SPRING, hold-down
	36C82628H09	KNOB, volume
	36C82628H08	KNOB, squelch
	1V80770A80	HANDLE, assembly
	13B83560E01	ESCUTCHEON (bottom)

CRYSTAL UNIT, receiver EPD-18951-O

		CRYSTAL UNIT, quartz: (SEE NOTE II)
Y3	AN-95 or AN-96	30-42 mc (NRB6152AB) 42-54 mc (NRB6153AB)
Y4	G19 or G20	receiver IF

NOTES:

I. Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.
II. Crystals are part of the complete radio set model (not part of the receiver model). When ordering crystal units, specify carrier frequency, crystal frequency and crystal part (type) number.

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
A	NLN6568A-1	R116	WAS 6S128903, 39K	Q105 COL-LECTOR	DECODER BD. PEPD-18257-O
B	NLN6568A-2	XDS101	WAS 9B83567E01	PARTS LIST	DECODER BD. PEPD-18257-A
B1			VOLTAGE READINGS & WAVEFORMS ADD-ED	SCHEMATIC DIAGRAM	
B2	NLN6568A-2	C114	ADDED WAS CON-NECTED TO PLATING SIDE OF BD.	Q102 BASE	DECODER BD. PEPD-18257-B

PARTS LIST

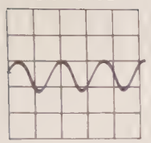
NLN6568A Single-Tone Decoder EPD-17816-B

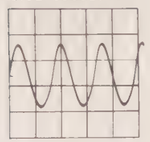
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf; ±10%; unl stated
C101, 102, 105	8D82905G11	0.22; 50 v
C103, 104, 111	21D83596E01	.001; 500 v
C106	8D82905G03	.047; 100 v
C107, 108	23K865136	15; 25 v
C109, 110	21C82372C04	.05 +80-20%; 25 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101, 102	48C82392B03	silicon
		LAMP, incandescent:
DS101	65C83573E01	.065 amp; 12 v
		TRANSISTOR: (SEE NOTE)
Q101 thru 105, 107, 108	48R134665	N-P-N; type M4665
Q106, 109	48R869312	P-N-P; type M9312
		RESISTOR, fixed: ±10%; 1/4 w unl stated
R101	6S128987	120K
R102	6S129147	220K
R103, 106, 112	6S127804	4.7K
R104	6S128903	39K
R105, 111, 122	6S129230	12K
R107	6S129229	180K
R108	6S129227	270K
R109	18C82193H05	var: 10K
R110	6S129144	68K
R113	6S127800	220
R114, 127	6S128904	18K
R115, 120	6S128902	47K
R116	6S128683	150K ±5%
R117	6S129242	5.6K
R118	6S127802	1K
R119, 131	6S129232	3.9K
R121	6S129861	65
R123	6S128687	6.8K
R124, 125	6S128689	2.2K
R126, 129, 130	6S128685	22K
R128	6S131652	39
		SWITCH, slide:
S101	40B83890A02	dpdt
S102	40B83547E01	spst
		LAMPHOLDER:
XDS101	9B83567E02	midget type; spring loaded; screw base
NON-REFERENCED ITEM		
	9A83445D01	CONNECTOR, receptacle: male single cont.

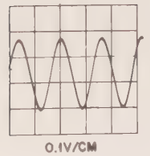
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
NLN6576AA Tone Kit NLN6576AB Tone Kit		EPD-17815-A
		CAPACITOR, fixed: uf ±1%; 50 v
C114	8D83445B58	0.079
	or8D83445B59	0.067
	or8D83445B60	0.064
	or8D83445B61	0.058 — Factory Selected
	or8D83445B62	0.053
	or8D83445B63	0.050
	or8D83445B64	0.044
		COIL ASSEMBLY:
L101	24V80905A99	incl: 24C83194A03 COIL WINDING; coded GRN; 76B83066A04 CORE, tuning; 7A83064A01 BRACKET, coil retaining; 4A83065A01 WASHER; 64A83063A01 PLATE, coil mtg. 3S1990 MACHINE SCREW; 29S5369 LUG, solder; Model NLN6576AA only
	or24V80906A01	incl: 24C83194A02 COIL WINDING; coded RED; 76B83066A04 CORE, tuning; 7A83064A01 BRACKET, coil retaining; 4A83065A01 WASHER; 64A83063A01 PLATE, coil mtg. 3S1990 MACHINE SCREW; 29S5369 LUG, solder; Model NLN6576AB only

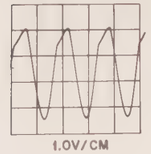
NOTE:

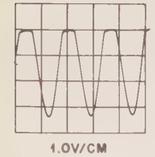
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



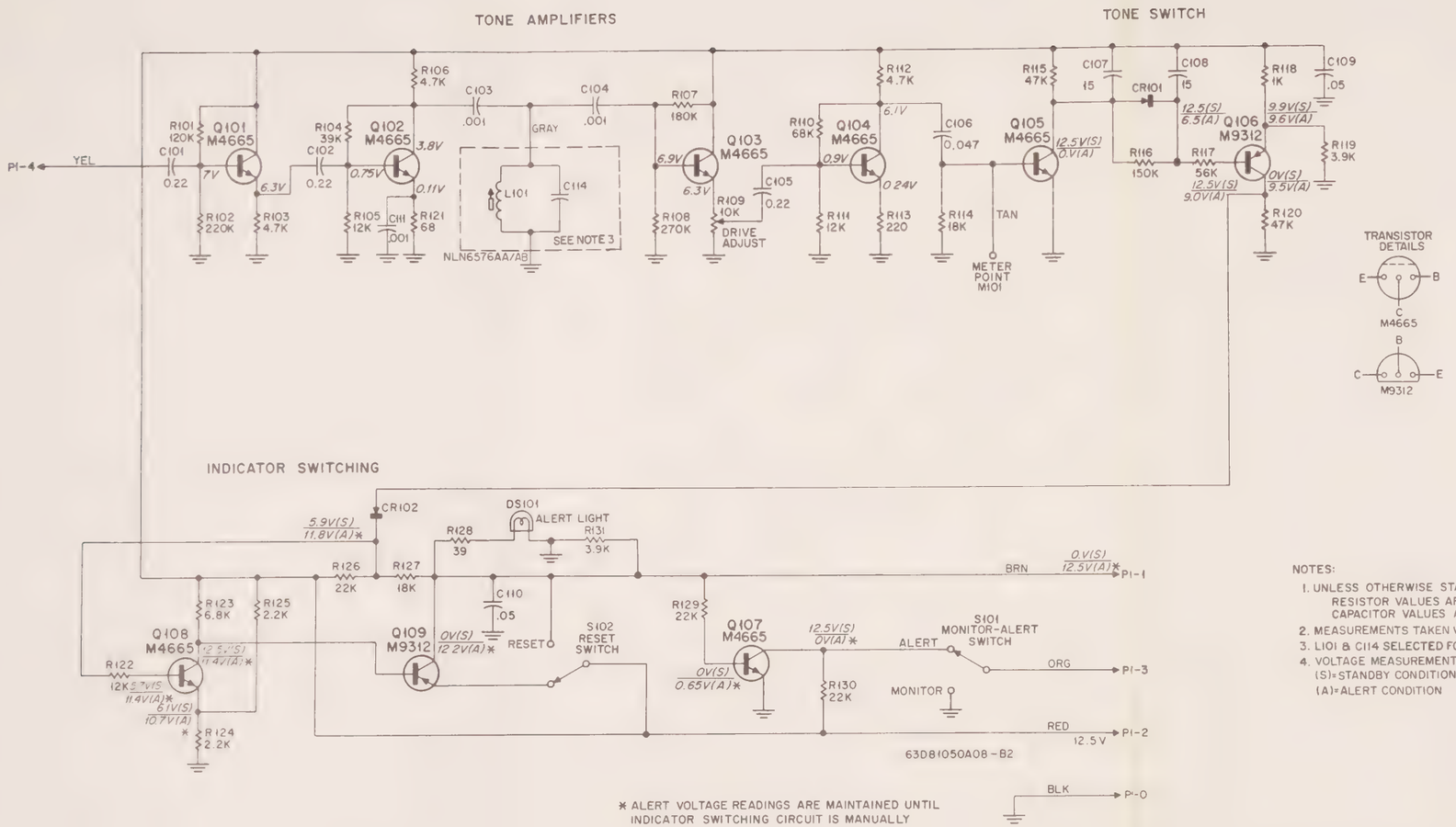








BEPD-20880-0



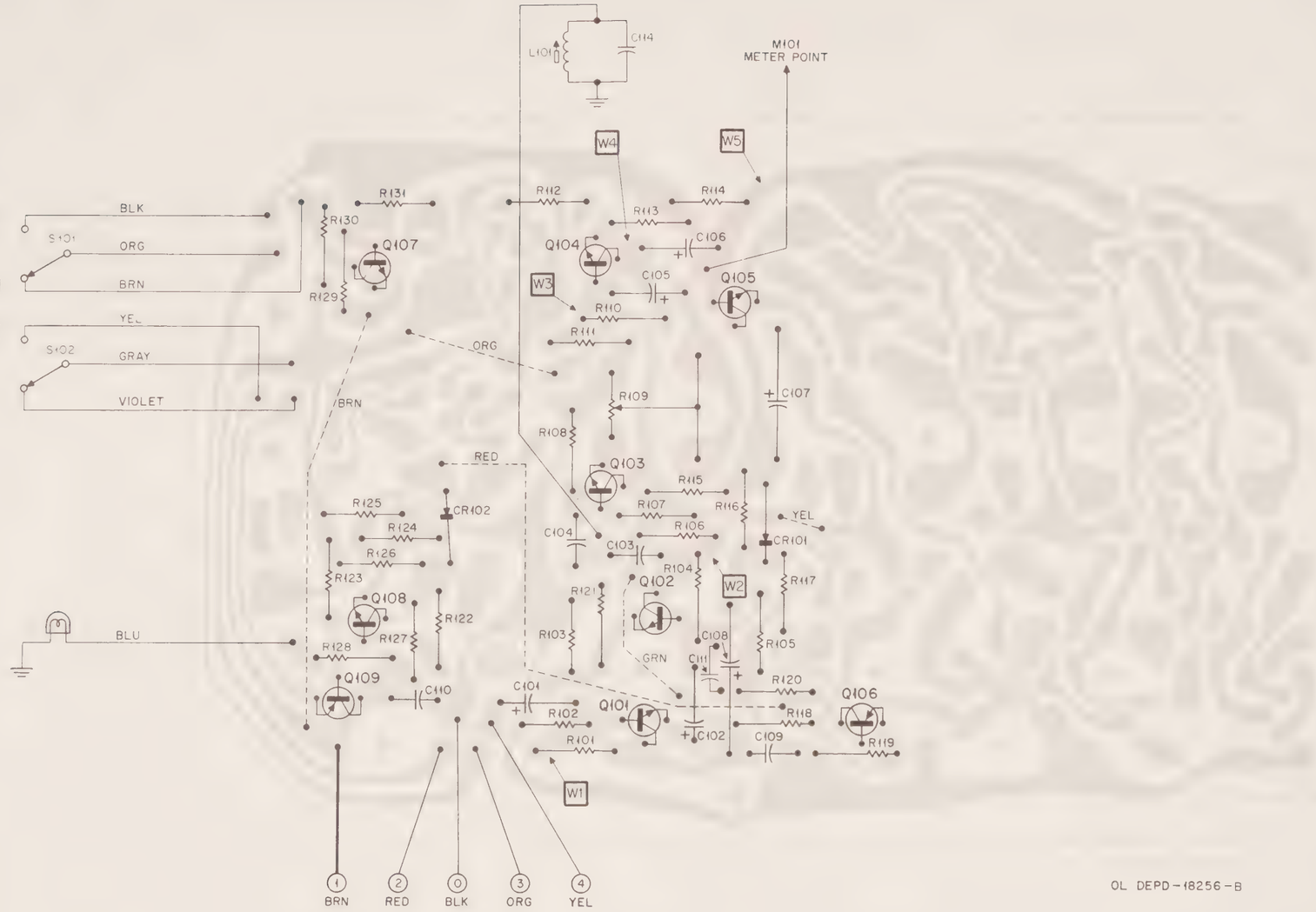
* ALERT VOLTAGE READINGS ARE MAINTAINED UNTIL INDICATOR SWITCHING CIRCUIT IS MANUALLY RESET BY S102.

NOTES:

1. UNLESS OTHERWISE STATED
   RESISTOR VALUES ARE IN OHMS, ±10%, 1/4 WATT.
   CAPACITOR VALUES ARE IN MICROFARADS.
2. MEASUREMENTS TAKEN WITH +12 5 VOLTS DC
3. L101 & C114 SELECTED FOR CUSTOMER TONE FREQUENCY
4. VOLTAGE MEASUREMENTS LEGEND:
   (S)=STANDBY CONDITION
   (A)=ALERT CONDITION

PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON FRONT OF THIS DIAGRAM

Model NLN1046A
Single-Tone Decoder Unit
Schematic Diagram
Motorola No. 63D81050A08-B2
2/16/68-AP



OL DEPD-18256-B

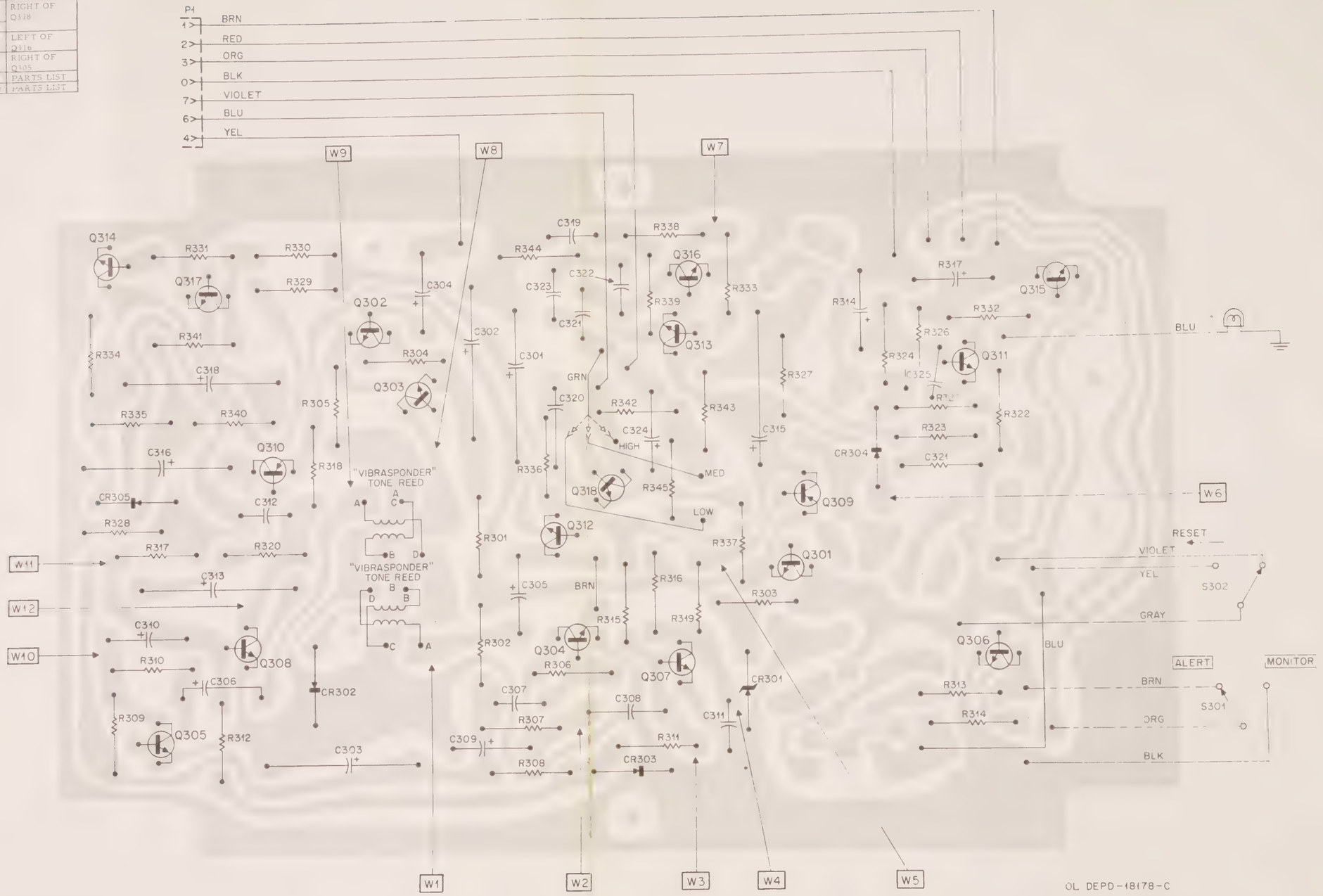
REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	NLN6568A-1	R111	WAS 39K	RIGHT OF Q103
	NLN6568A-2	XDS101	WAS 9B83567E01	PARTS LIST
B	NLN6568A-2	C111	ADDED	Q102 BASE

Model NLN1046A
Single-Tone Decoder Unit
Printed Circuit Board Detail
Motorola No. PEPD-18257-B
2/16/68-AP

REVISIONS

DIAG ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	Q316 COLLECTOR
		[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	RIGHT OF Q318
		R343	[illegible]	[illegible]
		R344	[illegible]	LEFT OF Q316
		[illegible]	[illegible]	RIGHT OF Q305
B	NLN6578A-2	XDS301	WAS 9B835e7E01	PARTS LIST
	NLN6578A-3	[illegible]	WAS 21K847064; 150 V	PARTS LIST



OL DEPD-18178-C

Model NLN6578A
Two-Tone Sequential Decoder Unit
Printed Circuit Board Detail
Motorola No. PEPD-18179-C
2/16/68-AP

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
O.	NLN6578A	R342	WAS 6S128904, 18K	Q318 COLLECTOR	DECODER BD. PEPD-18179-A
		R345	WAS 6S129247, 560K		
		R343	WAS 6S127805, 15K		
		R344	WAS 6S128687, 6.8K	Q316 COLLECTOR	
		C321	WAS 21R410115, 220 uuf		
		C325	ADDED .01 uf	Q311 EMITTER	
A	NLN6578A-1	C303	WAS 23D83214C07, 22 uf	Q301 EMITTER	DECODER BD. PEPD-18179-A
B	NLN6578A-2	XDS301	WAS 9B83567E01	PARTS LIST	PEPD-18179-B
B.			VOLTAGE READINGS & WAVEFORMS ADDED		
C	NLN6578A-3	C325	WAS 21K847064, 150 V	PARTS LIST	PEPD-18179-C
C.	NLN6578A-3		ADDED 9C83035A06	PARTS LIST	SOCKET

PARTS LIST

NLN6578A Two-Tone Sequential Decoder Kit EPD-18216-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf ±10%; 50 v; unl stated
C301, 302, 313, 315, 316	23D83214C07	22 ±20%; 15 v
C303	23K868446	47 ±20%; 6 v
C304, 309	8D82905G25	.0033; 100 v
C305, 306, 320	8D82905G11	0.22
C307, 319, 321, 322, 323	21D83596E01	.001; 500 v
C308, 310, 314, 317, 324	8D82905G03	.047
C311, 312	21D82428B25	.002 ±20%; 500 v
C318	23D83214C02	15 ±20%; 25 v
C325	21D82428B12	.01 +70-30%; 100 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR301	48D83461E10	zener
CR302, 303	48C82178A06	germanium
CR304	48C82392B03	silicon
CR305	48K855216	germanium
		LAMP, incandescent:
DS301	65C83573E02	.065 amp; 14 v
		TRANSISTOR: (SEE NOTE I)
Q301, 302, 304 thru 308, 311 thru 314, 316, 317	48R869532	N-P-N; type M9532
Q303, 309, 310, 315, 318	48R869514	P-N-P; type M9514
		RESISTOR, fixed: ±10%; 1/4 w unl stated
R301	6S128689	2.2K
R302	6S129752	270
R303, 319, 333	6K127802	1K
R304	6K129226	100K
R305, 322, 342	6S127806	27K
R306, 310, 315, 317	6S129247	560K
R307, 308, 309, 318, 334	6S128686	5.2K
R311, 312, 313, 314	6S128685	22K
R316	6K128903	39K
R320, 327	6S128687	6.8K
R321, 328, 335	6S129225	10K
R323	6K129235	1.2K
R324	6S129230	12K
R325, 338, 339	6S128683	150K ±5%
R326, 337, 344	6S128904	18K
R329, 331	6S128987	120K
R330, 345	6S129147	220K
R332	6S131652	39
R336, 340	6S129242	56K
R341	6S127805	15K
R343	6S128688	2.7K
R346	6S129232	3.9K
		SWITCH, slide:
S301	40B83890A02	dpdt
S302	40B83547E01	spdt
		LAMPHOLDER:
XDS301	9B83567E02	miniature; screw base
NON-REFERENCED ITEMS		
	9C83035A01	SOCKET, reed: min; 4 cont.
	9C83035A03	SOCKET, reed: min; 4 cont.

"Vibrasponder" Reed

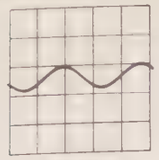
	TLN6709BG	625-1350 cps (SEE NOTE II)

NOTES:

I. Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

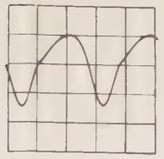
II. When ordering replacement "Vibrasponder" Resonant Reeds, specify exact reed frequency required.

W1
POINT A OF TONE REED "B"



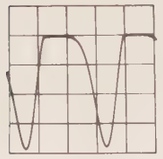
0.1V/CM

W2
Q304 COLLECTOR



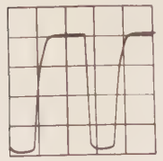
1.0V/CM

W3
Q307 BASE



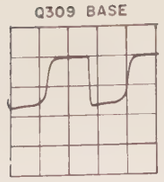
0.5V/CM

W4
Q307 COLLECTOR



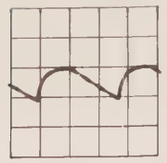
1.0V/CM

W5
Q309 BASE



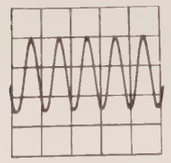
0.5V/CM

W6
Q309 COLLECTOR

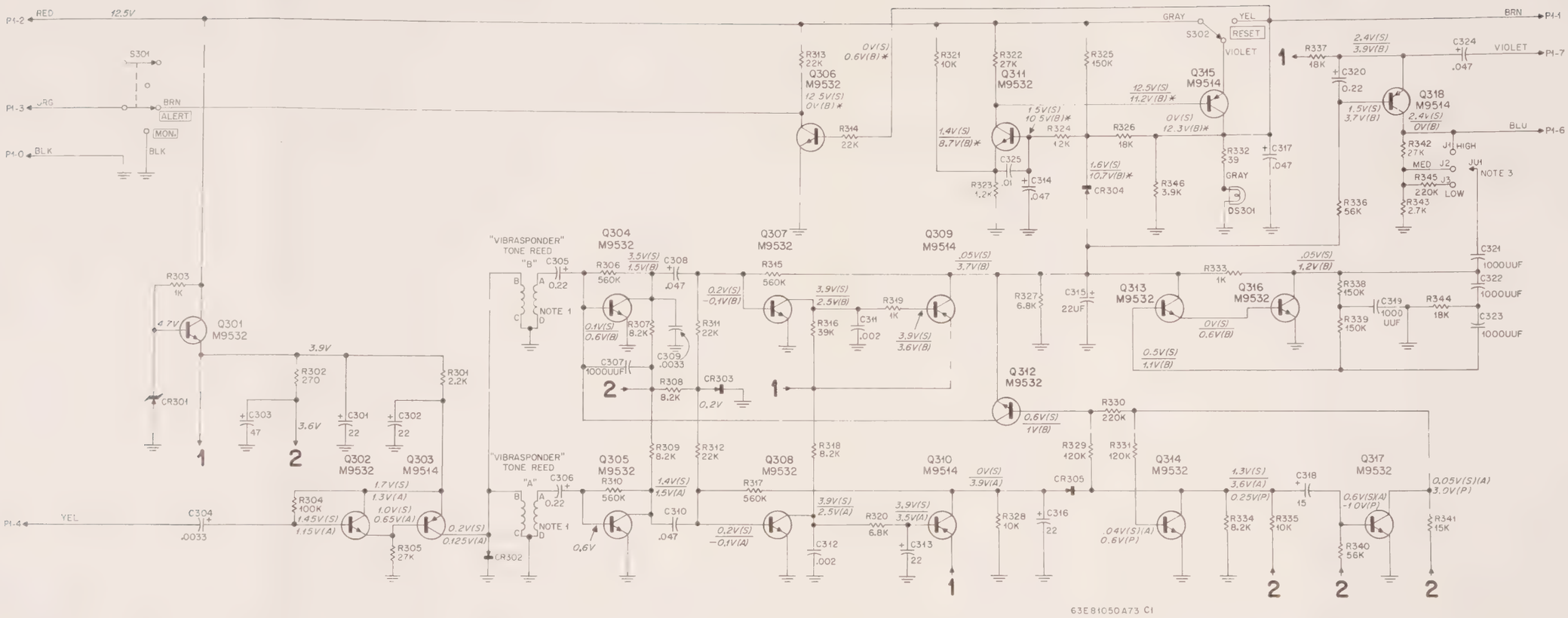


0.2V/CM

W7
Q316 COLLECTOR



1.0V/CM



63E81050A73 C1

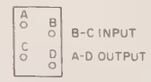
☆ONCE ALERTED THIS VOLTAGE REMAINS IN THE ALERT CONDITION UNTIL RESET SWITCH S302 IS ACTIVATED.

NOTES:

1. "VIBRASPONDER" RESONANT REEDS SUPPLIED SEPARATELY.
2. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN MICROFARADS.
3. CONNECT JU1 TO:
   J1 FOR HIGH LEVEL ALERT TONE, (2W)
   J2 FOR MEDIUM LEVEL ALERT TONE, (500MW)
   J3 FOR LOW LEVEL ALERT TONE, (50MW)
4. CODE SEQUENCE: A-B
5. VOLTAGE READINGS LEGEND:
   (S) = STANDBY CONDITION
   (A) = TONE "A" APPLIED TO REED DRIVER
   (B) = TONE "B" APPLIED TO REED DRIVER
   (P) = PULSE AT END OF TONE "A"
6. VOLTAGE READINGS WILL VARY DEPENDING ON FREQUENCY OF TONES USED
7. REFER TO CIRCUIT BOARD DETAIL FOR MEASUREMENT POINTS.

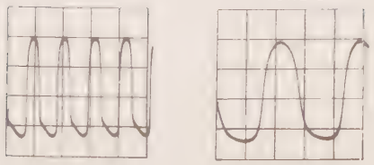
TRANSISTOR DETAIL

M9514, M9532



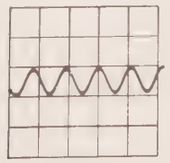
REED SOCKET (BOTTOM VIEW)

W8
W303 COLLECTOR



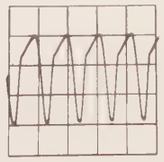
0.1V/CM

W9
POINT A OF TONE REED "A"



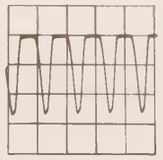
0.1V/CM

W10
Q305 COLLECTOR



1.0V/CM

W11
Q308 BASE



1.0V/CM

W12
Q308 COLLECTOR

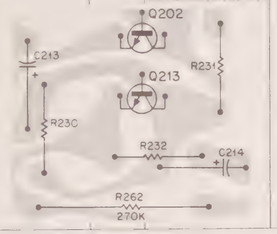
1.0V/CM

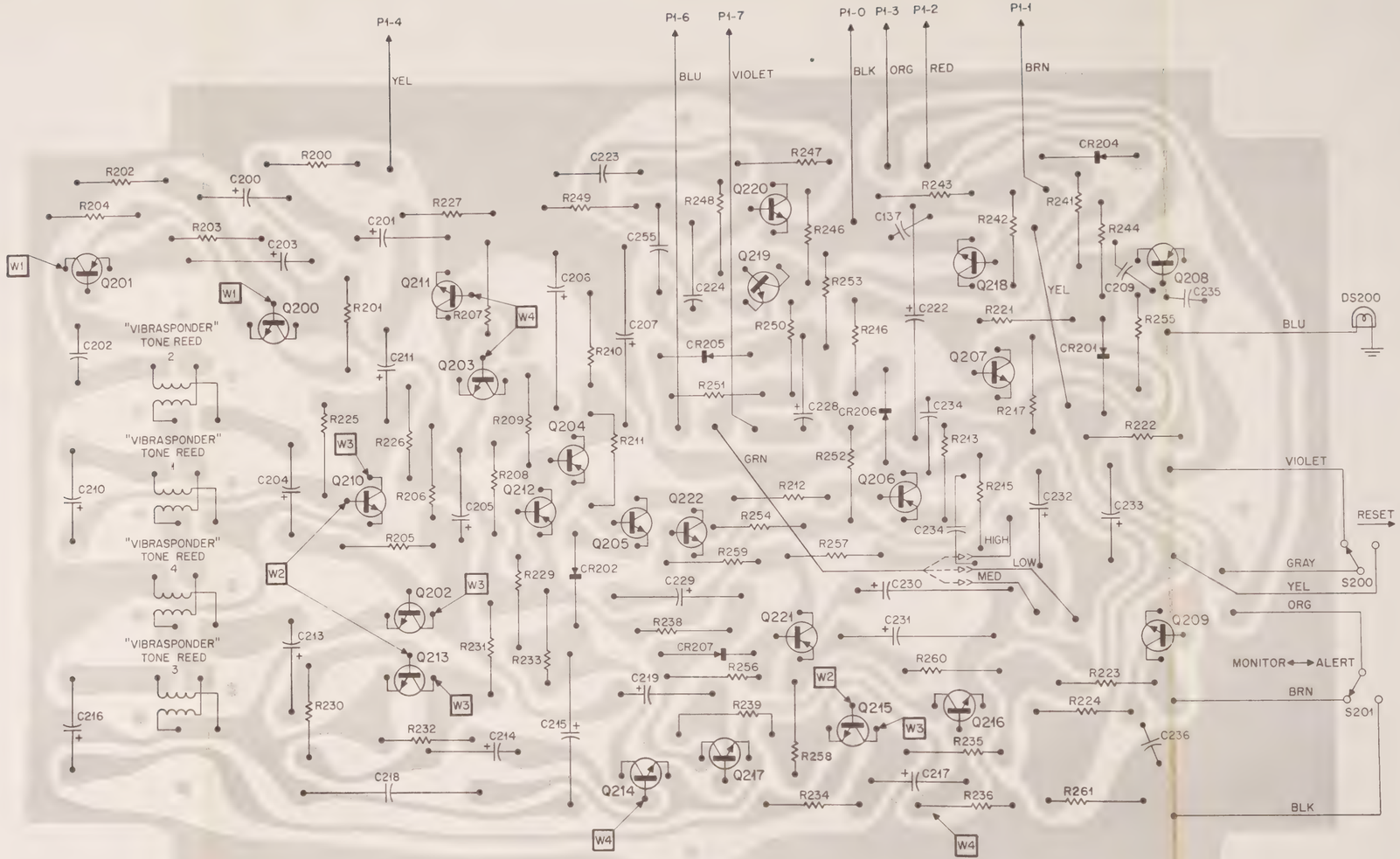
DEPD-20881-0

Model NLN6578A
Two-Tone Sequential Decoder
Schematic Diagram
Motorola No. 63E81050A73-C1
2/16/68-AP

REVISIONS

DIAG ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	NLN6577A	[illegible]	ADDED	Q202, [illegible]
B	NLN6577A	[illegible]	RELOCATED WAS CONNECTED BETWEEN GND AND JUNCTION OF R224, [illegible]	MOVED TO Q216
C	NLN6577A-1	Q253, [illegible]	ADDED	Q208, Q209, [illegible]
		R262	ADDED	Q211
		[illegible]	REMOVED. WAS CONNECTED BETWEEN Q211 EMITTER AND COLLECTOR	
D	NLN6577A-2	[illegible]	[illegible]	[illegible]
E	NLN6577A-3	R262	REMOVED [illegible]	





OL DEPD-18259-E

Model NLN6577A
"Quik-Call" Decoder Unit
Printed Circuit Board Detail
Motorola No. PEPD-18260-E
2/16/68-AP

PARTS LIST

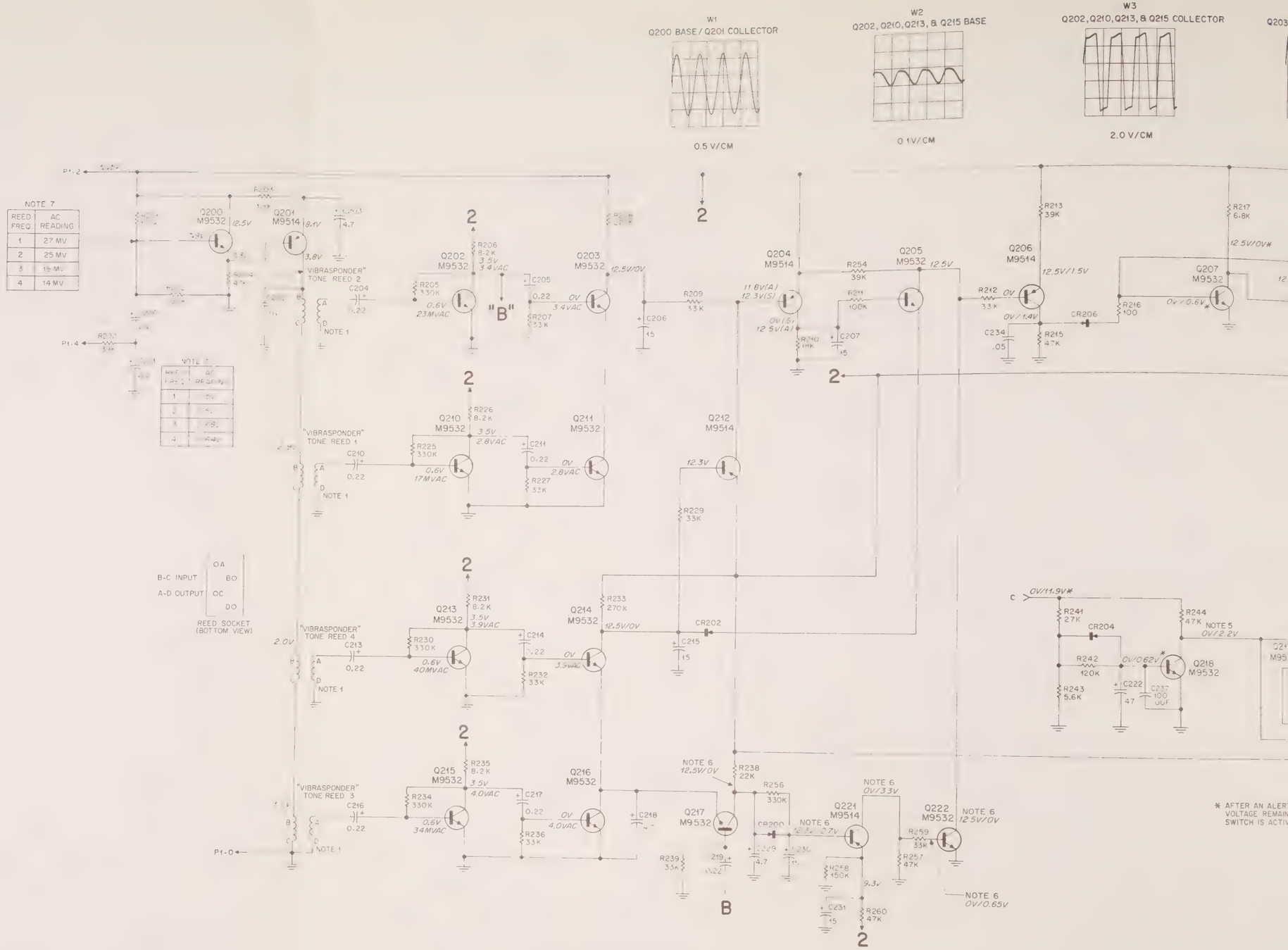
NLN6577A "Quik-Call" Decoder — EPD-18116-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf ±10%; unl stated
C200, 201	8D82905G23	.02; 100 v
C202	21D82428B12	.01 +70-30%; 100 v
C203, 229	23K865137	4.7 ±20%; 25 v
C204, 205, 210, 211, 213, 214, 216, 217, 219	8D82905G11	0.22; 50 v
C206, 207, 215, [illegible]	23K865136	15 ±20%; 25 v
[illegible]	21C82372C04	.05 +80-20%; 25 v
[illegible]	23K865137	4.7 ±20%; 25 v
[illegible]	23K868446	47 ±20%; 6 v
C223, 224, 225	21D83596E01	.001; 500 v
C228, 233	8D82905G07	0.1; 50 v
C232	8D82905G04	.068; 100 v
C235, 236, 237	21D82133G03	100 uuf ±5%; 500 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR200, 201, 202, 205	48C82392B03	silicon
CR204, 206	48C82921G04	germanium
		LAMP, incandescent:
DS200	65C83573E01	.065 amp; 14 v; min. screw type base
		TRANSISTOR: (SEE NOTE I)
Q200, 202, 203, 205, 207, 209, 211, Q213 thru Q220, 222	48R869532	N-P-N; type M9532
Q201, 204, 206, 208, 212, 221	48R869514	P-N-P; type M9514
		RESISTOR, fixed: ±10%; 1/4 w unl stated
R200, 213, 254	6K128903	39K
R201, 242	6S128987	120K
R202, 208, 250, [illegible]	6S129147	220K
[illegible]	6S129269	1.8K
R204, 215, 244, 257, 260	6S128902	47K
R205, 225, 230, 234, 256	6S129228	330K
R206, 226, 231, 235	6S128686	8.2K
R207, 209, 212, 227, 229, 232, 236, 239, 259	6S127807	33K
[illegible]	6S128904	15K
[illegible]	6S129226	100K
[illegible]	6S129753	100
[illegible]	6S128687	6.8K
[illegible]	6S131652	[illegible]
R223, 224, 238, [illegible]	6S128685	22K
[illegible]	6S129227	270K
[illegible]	6S127806	47K
R245, 246, 252	6S129433	[illegible]
[illegible]	6S128689	5.6
R247, 248, 258	6S129146	150K
[illegible]	6S129013	1 meg
[illegible]	6S129231	3.3K
[illegible]	6S129232	3.9K
XDS200	9B83567E02	LAMPHOLDER: miniature; screw base
NON-REFERENCED ITEMS		
	9C83035A01	SOCKET, reed; min. 4 cont.
	9C83035A03	SOCKET, reed; min. 4 cont.
"Vibrasponder" Reed		
	TLN6709BG	625-1350 cps (SEE NOTE II)

NOTES:

I. Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

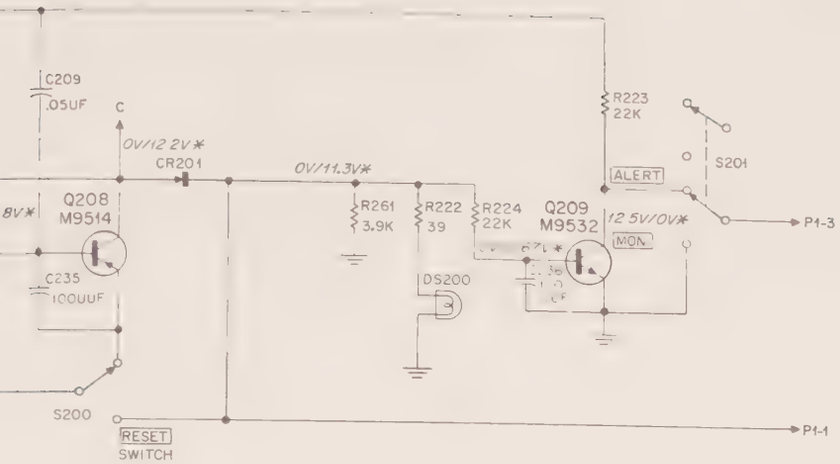
II. When ordering replacement "Vibrasponder" Resonant Reeds, specify exact reed frequency required.

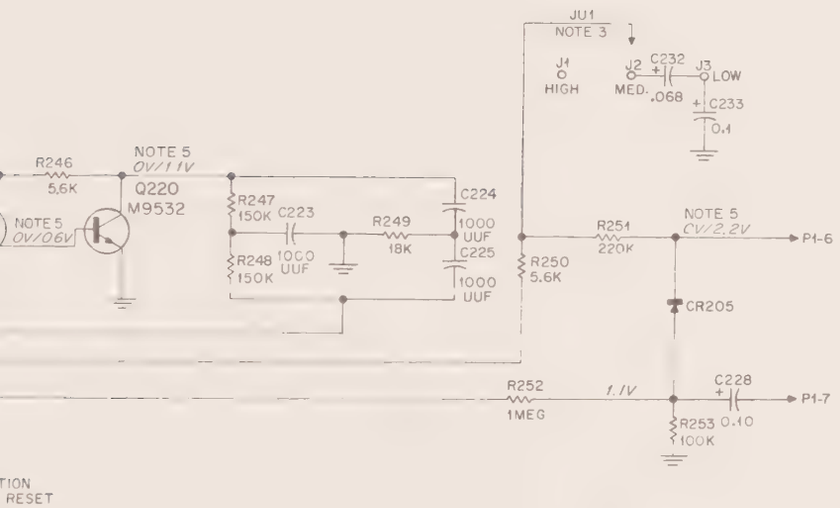


W4
Q214, & Q216 BASE

BEPD-20859-0

2.0 V/CM





63E81051A04-C1

TRANSISTOR DETAIL

M9514, M9532

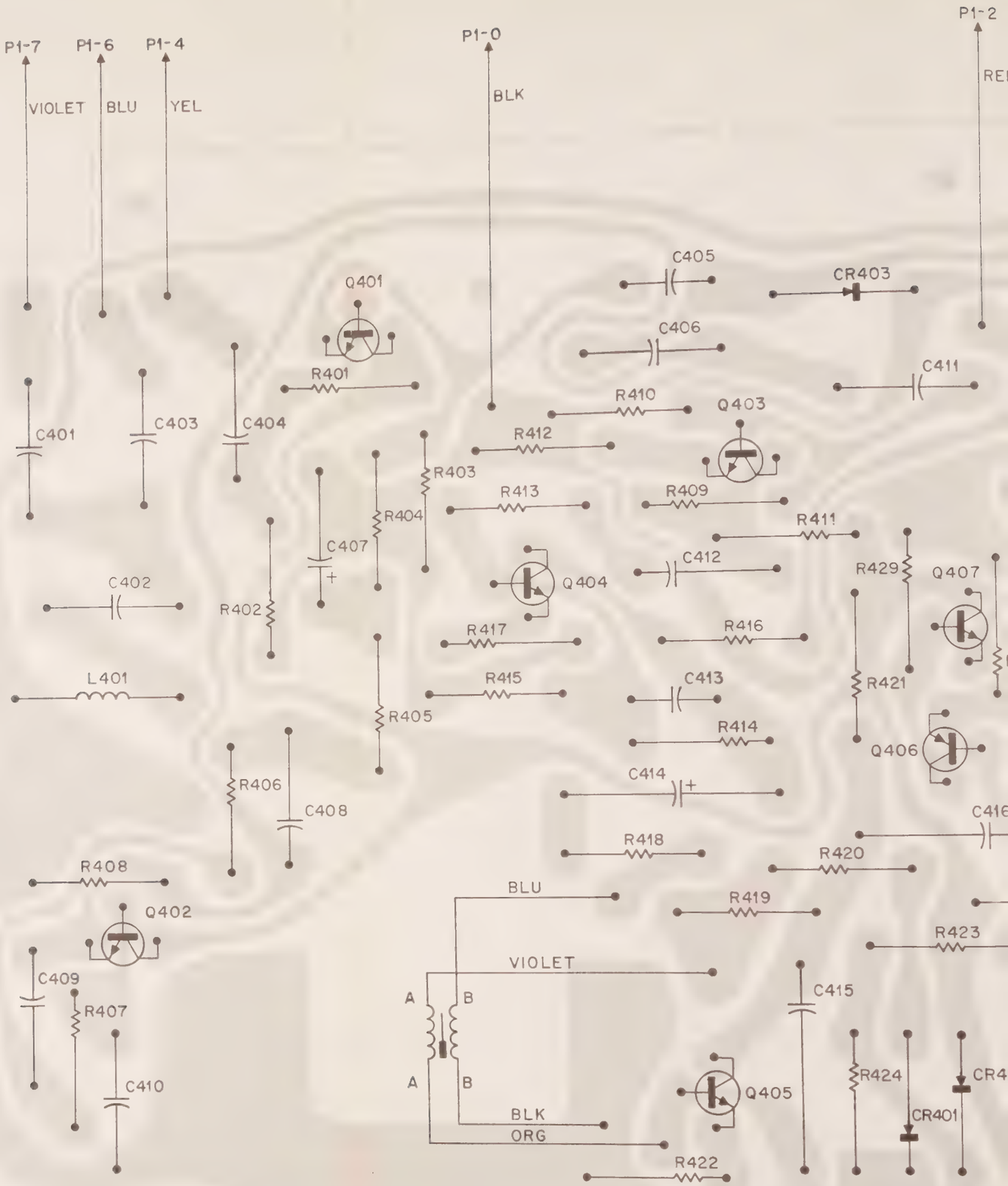
NOTES:

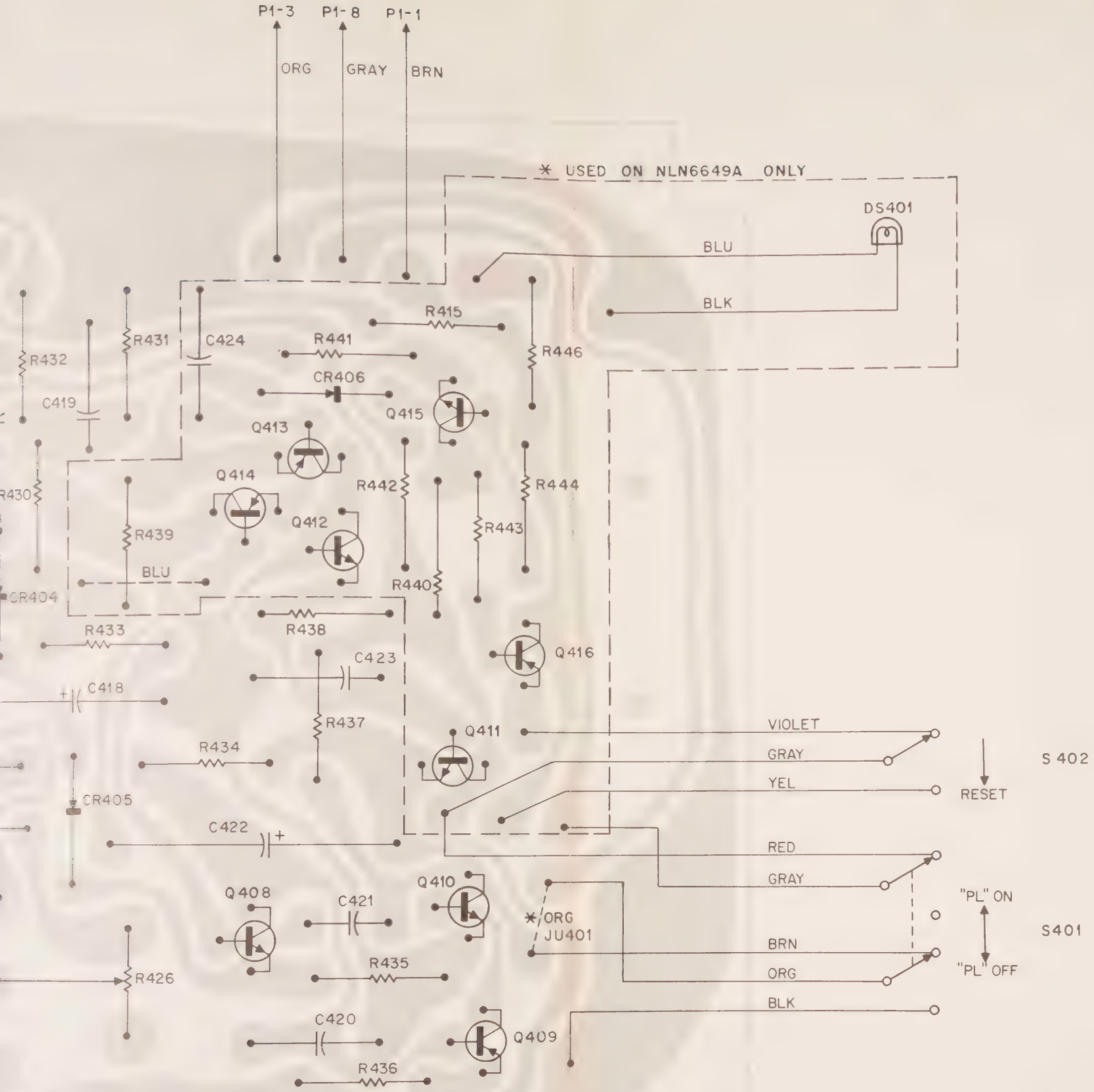
1. "VIBRASPONDER" RESONANT REEDS SUPPLIED SEPARATELY.
2. ALL CAPACITANCES EXPRESSED IN MICROFARADS EXCEPT AS OTHERWISE NOTED.
3. CONNECT J1 TO:
   J1 FOR HIGH LEVEL ALERT TONE.
   J2 FOR MEDIUM LEVEL ALERT TONE.
   J3 FOR LOW LEVEL ALERT TONE.
4. "QUIK-CALL" CODE: (12)-(34)
   GROUP-CALL CODE: (23)
5. ACTIVATES ONLY DURING ALERT TONE PERIOD & THEN REVERTS BACK TO QUIESCENT (STANDBY) STATE.
6. ACTIVATED ONLY DURING GROUP CALL OPERATION.
7. READINGS WILL VARY DEPENDING ON REED FREQUENCY.
8. (A) ALERT CONDITION.
   (S) STANDBY

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
[illegible]	[illegible]	R247	WAS 6S129233, 5.6K	Q216 BASE	DECODER BD PEPD-18260-B
		J4*	ADDED	Q216 COLLECTOR	
O2	NLN6577A	C209	RELOCATED WAS CONNECTED BETWEEN GND AND JUNCTION OF CR201, R261	Q208 COLLECTOR CIRCUIT	DECODER BD PEPD-18260-B
A	NLN6577A-1	C218	WAS 23K865136, 15 uf	Q216 COLLECTOR	DECODER BD. PEPD-18260-C
		CR206	WAS 48C82392B03	PARTS LIST	
		R210	WAS 6S129433, 5.6K	Q204 COLLECTOR	
		R2[illegible]	ADDED	Q211 COLLECTOR	
		C2[illegible]	ADDED	Q208 BASE	
		C2[illegible]		Q206 BASE	
		C2[illegible]		C216 BASE	
		C212	REMOVED 23K865136, 15 uf WAS CONNECTED BETWEEN EMITTER AND COLLECTOR OF Q211	Q211	
P	NLN6577A-2	XDS200	WAS 9B83567E01	PARTS LIST	DECODER BD. PEPD-18260-D
	NLN6577A-3	R262	REMOVED 6S129227, 270K, WAS CONNECTED BETWEEN EMITTER & COLLECTOR OF Q211.	Q211	DECODER BD. PEPD-18260-E
C1	NLN6577A-3	NON-REFER	ADDED 9C83035A03	PARTS LIST	NONE

Model NLN6577A "Quik-Call" Decoder
Schematic Diagram
Motorola No. 63E81051A04-C1
2/16/68-AP

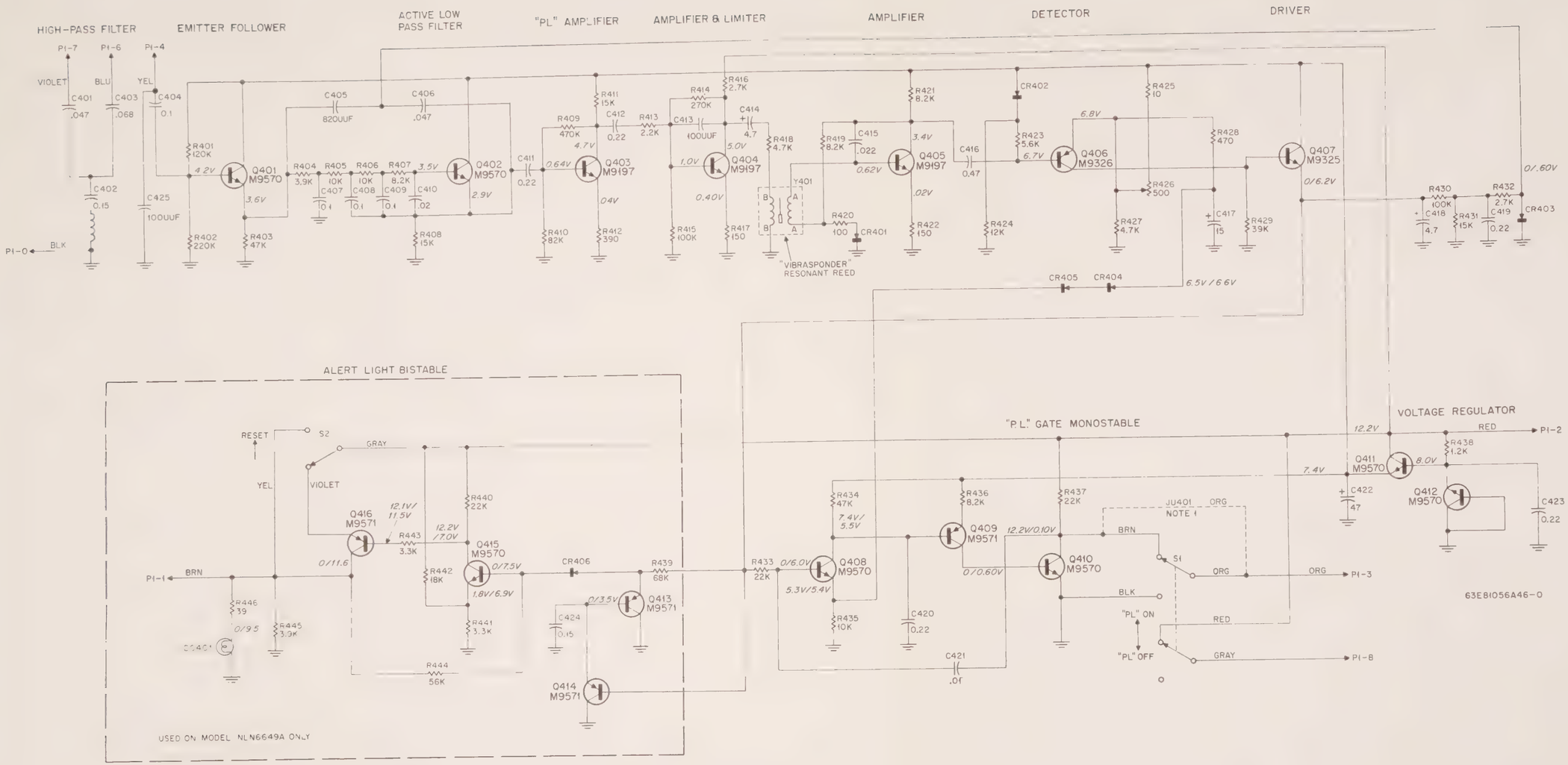

P1-7
P1-6
P1-4
P1-0
P1-2
VIOLET
BLU
YEL
BLK
C401
C403
C404
Q401
R401
C405
CR403
C406
C411
R410
Q403
R412
R403
R413
R409
R404
C407
R411
C412
C402
R402
Q404
R429
Q407
R417
R416
L401
R415
C413
R405
R421
R414
Q406
C414
R406
C408
C416
R418
R420
R408
BLU
R419
Q402
R423
VIOLET
C409
R407
C415
A
B
A
B
C410
Q405
R424
CR4
CR401
BLK
ORG
R422

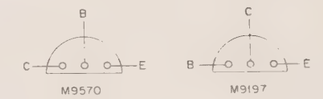

P1-3
P1-8
P1-1
ORG
GRAY
BRN
* USED ON NLN6649A ONLY
DS401
BLU
BLK
R415
R441
R446
R431
C424
R432
C419
CR406
Q415
Q413
Q414
R442
R444
R430
R439
Q412
R443
BLU
R440
CR404
R438
R433
C423
Q416
C418
R437
Q411
VIOLET
GRAY
YEL
S 402
RESET
R434
CR405
C422
RED
GRAY
Q410
Q408
C421
"PL" ON
S401
*ORG
JU401
BRN
R435
ORG
"PL" OFF
R426
BLK
C420
Q409
R436

NOTES:

1. IN TAMPER-PROOF MODEL, S1 IS REPLACED BY JU401.
2. ALL CAPACITANCES ARE IN MICROFARADS EXCEPT WHERE OTHERWISE NOTED.
3. "VIBRASPONDER" RESONANT REED SUPPLIED SEPARATELY.
4. DC VOLTAGE READINGS TAKEN WITH 13.8 VOLTS DC INPUT, AND ARE REFERRED TO CHASSIS GROUND. S = STANDBY CONDITION; O = VOLTAGE DURING "PRIVATE-LINE" OPERATION

EPD-21376-O





TRANSISTOR DETAILS

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Models NLN6648A, NLN6649A
"Private-Line" Decoder Units
Schematic Diagram
Motorola No. 63E81056A46-O
2/16/68-AP

PARTS LIST

NLN6648A "Private-Line" Decoder and Filter Kit
NLN6649A "Private-Line" Decoder and Filter Kit EPD-21299-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf ±10%; 50 v, unl. stated
C401, 406	8D82905G03	.047
C402	8D82905G05	0.15
C403	8D82905G04	.068
C404, 407, 408 409	8D82905G07	.10
C405	21D82187B21	820; uuf; 200 v
C410	8D82905G23	.02; 100 v
C411, 412, 419 420, 423	8D82905G11	0.22
C413, 425	21D82133G03	100 uuf ±5%
C414, 418	23K865137	4.7 ±10%; 25 v
C415	8D82905G43	.022; 200 v
C416	8D82905G49	0.47
C417	23K865136	15 ±10%; 25 v
C421	21D82428B12	.01; 100 v
C422	23D82783B31	47 ±20%; 20 v
C424	8D82905G05	0.15 (NLN6649A only)
		SEMICONDUCTOR, DEVICE: diode; (SEE NOTE)
CR401, 402 403, 404, 405	48C82392B03	silicon; SG3182
CR406	48C82392B03	silicon; SG3182 (NLN6649A only)
		LAMP, incandescent:
DS401	65C83573E01	min. screw base; .065 amps. 12 v (NLN6649A only)
		COIL, AF
L401	25C82024D02	choke; 6.6 h
		TRANSISTOR: (SEE NOTE)
Q401, 402, 408 410, 411, 412	48R869570	N-P-N; type M9570
Q403, 404, 405	48R869197	N-P-N; type M9197
Q406	48R869326	P-N-P; type M9326
Q407	48R869325	N-P-N; type M9325
Q408	48R869571	N-P-N; type M9571
Q413, 414, 416	48R869571	N-P-N; type M9571 (NLN6649A only)
Q415	48R869570	N-P-N; type M9570 (NLN6649A only)
		RESISTOR, fixed ±10%; 1/4 w; unl. stated
R401	6S128987	120K
R402	6S129147	220K
R403, 418, 427	6S127804	4.7K
R404	6S129232	3.9K
R405, 406, 435	6S129225	10K
R407, 419, 421 436	6S128686	8.2K
R408, 411, 431	6S127805	15K
R409	6S129148	470K
R410	6S129145	82K
R412	6S129863	390
R413	6S128689	2.2K
R414	6S129227	270K
R415, 430	6S129226	100K
R416, 432	6S128688	2.7K
R417, 422	6S129862	150
R420	6S129753	100
R423	6S129433	5.6K
R424	6S129230	12K
R425	6S129755	10
R426	18C82193H08	var, 500 ohms; ±10%; 1/4 w
R428	6S127801	470
R429	6S128903	39K
R433, 437	6S128685	22K
R434	6S128902	47K
R438	6S129235	1.2K
R439	6S129144	68K (NLN6649A only)
R440	6S128685	22K (NLN6649A only)
R441, 443	6S129231	3.3K (NLN6649A only)
R442	6S128904	18K (NLN6649A only)
R444	6S129242	56K (NLN6649A only)
R445	6S129232	3.9K (NLN6649A only)
R446	6S131652	39 (NLN6649A only)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SWITCH, slide:
S401	40B83890A02	dpdt
S402	40B83547E01	spdt (NLN6649A only)
		LAMPHOLDER,
XDS401	9B83567E02	min. screw base (NLN6649A only)

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.